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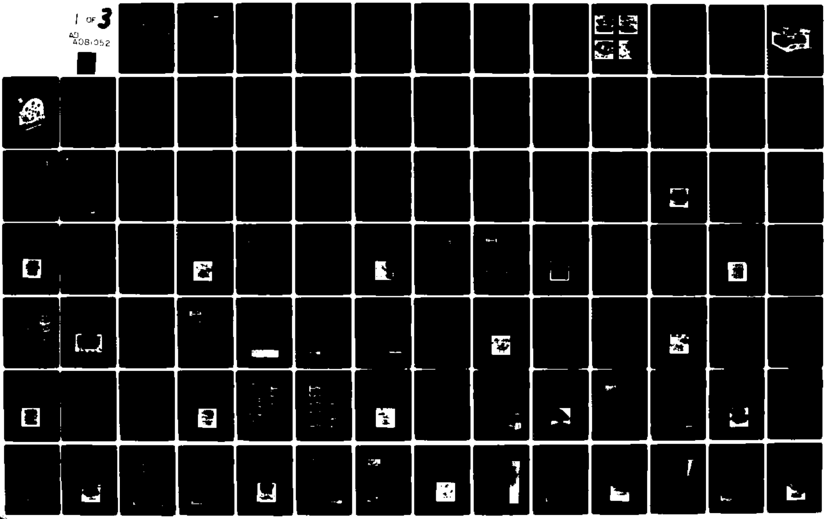

CINCINNATI ELECTRONICS CORP.

CTR-79-0012

LEVEL II

TECHNICAL REPORT

RADIOMETRIC MEASUREMENTS BY THE MIDAS III SYSTEM AT KEY WEST

VOLUME 1: CLOUD BACKGROUNDS

AUTHOR: A. Geiser, C. Dippel, V. O'Connell, S. Bertke

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This report describes the test equipment, test procedures, test site and test results for a program to measure the infrared signatures of a representative sample of cloud backgrounds and aircraft at Key West, Florida. Data on various clouds were gathered between April 26 & May 10, 1979, and data on F-4 and F-14 aircraft were gathered between June 4 & June 19, 1979. The MIDAS III radiometer was used to measure the infrared radiometer was used to measure the infrared signatures of the aircraft during the day and a number of different types of cloud backgrounds at various

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times of the day and night and at various angles with respect to the sun. The MIDAS III System is a small-field scanning radiometer that makes simultaneous measurements of infrared sources in the 3-5 and 8-13 micrometer spectral regions. The 3-5 spectral region is further sub-divided into smaller spectral bands by inserting various spectral filters in front of the 3-5 detector.

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A

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FOREWORD

This final report documents the results of some field measurements at Key West, Florida from April 26 through May 10, 1979, and from June 4 through June 10, 1979. The measurements were made by Cincinnati Electronics Corporation using the MIDAS III equipment. During the first half of the program banded infrared radiometric data was collected on a series of cloud backgrounds under various conditions. During the second half of the program banded infrared radiometric data was collected on some aircraft flights. The cloud data is reported in Volume 1 of this final report and the aircraft data is included in Volume 2 which is a separate classified volume. This work was supported by the Optical Signatures Program, Naval Weapons Center, China Lake, CA under contract N60530-79-C-0031.

ACKNOWLEDGEMENTS

The author wishes to thank the OSP Program Manager, Dr. Jon Wunderlich (Code 39403), and the Project Monitor, Mr. Don Kappelman of the Naval Weapons Center, China Lake, for their support and assistance on this measurements program. The work was performed by the Advanced Systems, Engineering Analysis, and Measurements Group of the Electro-Optical Systems Department of Cincinnati Electronics Corporation under the supervision of Louis Williams. The Project Engineer was Al Geiser. Cincinnati Electronics field test personnel were Al Geiser and Charlie Dippel. Data reduction was done by Vicki O'Connell and Dr. Steve Bertke.

1.0 INTRODUCTION AND SUMMARY

This report describes the test equipment, test procedures, test site and test results for a program to measure the infrared signatures of a representative sample of cloud backgrounds and aircraft at Key West, Florida. Data on various clouds were gathered by Cincinnati Electronics Corporation between April 26 and May 10, 1979. Data on F-4 and F-14 aircraft were gathered between June 4 and June 10, 1979.

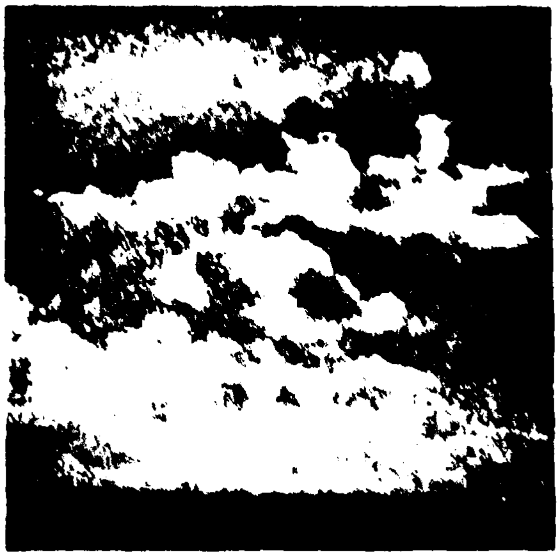
The MIDAS III radiometer was used to measure the infrared signatures of the aircraft during the day and a number of different types of cloud backgrounds at various times of the day and night and at various angles with respect to the sun. The MIDAS III system is a small-field scanning radiometer that makes simultaneous measurements of infrared sources in the 3-5 and 8-13 micrometer spectral regions (see references). The 3-5 spectral region is further subdivided into smaller spectral bands by inserting various spectral filters in front of the 3-5 detector.

The MIDAS system was located at the north end of Fleming Key in Key West. The system had an unobstructed view of a wide angle of sky and sea background with a number of small islands in the field of view. For the background measurements the MIDAS system was panned around to locate sectors in which there was detailed structure and/or intense signal levels. Representative samples of this data were then recorded. For the aircraft measurements the targets were tracked visually with a telescope which was boresighted with the infrared radiometer.

A camera was used to photograph most of the backgrounds in order to correlate the infrared signatures with the visual scenes. These pictures are presented along with the analog plot of background irradiance as a function of scan angle for various spectral bands.

A set of four typical cloud pictures is shown in Figure 1.1.

TARGET 9



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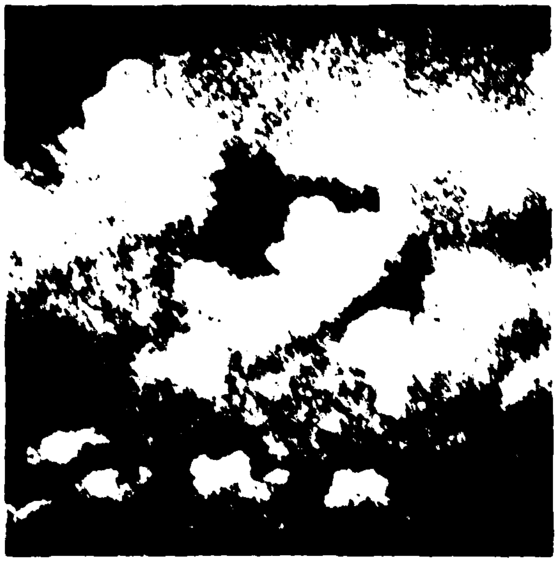

TARGET 21

TARGET 8

Figure 1.1. Typical Cloud Pictures

2.0 MIDAS SYSTEM DESCRIPTION

2.1 SCANNER AND CONTROL CONSOLE

MIDAS III is a banded radiometer used to gather target temporal and/or spatial data in several spectral bands. The system is modular and can be configured in a variety of ways. The MIDAS III System used for the Background Measurements at Key West is shown in the block diagram in Figure 2.1.1. The system consisted of the scanner and control, monitoring and recording electronics and a mobile support van. An external view of the scanner with the TV camera and sighting scope is shown in Figure 2.1.2. The UV sensor shown in Figure 2.1.1 was not used for the Key West tests. A single lens reflex (SLR) camera (not shown) was mounted on the top of the scanner across from the video camera.

The scanner unit contains two lenses side by side, a four-element germanium lens with an 8-13 um passband and a four-element (two germanium and two silicon) lens with a 3-5 um passband. Each of these lenses has a 7 inch aperture, a 21 inch focal length and a resolution of 0.10 milliradian. Behind each lens is a coated pyrex folding mirror which reflects the converging beams to opposite sides of the double sided coated aluminum scan mirror. The beam of the 8-13 um lens is reflected from the scan mirror to the 16 element mercury cadmium telluride (HgCdTe) detector located at the focal plane. The beam of the 3-5 um lens is reflected from the scan mirror to the 24 element indium antimonide (InSb) detector located at the focal plane. Both detectors have staggered arrays with 10 percent overlapping. Each element in the two arrays is 0.09 milliradian in azimuth by 0.11 milliradian in elevation. When convolved with the optical blur spot, the detector elements generate a system resolution of 0.1 milliradian in the azimuth direction by 0.12 milliradian in the elevation direction. The two staggered arrays in each detector are separated by 0.5 milliradian. Eight of the detector elements in each detector were used to record data. Thus the total elevation field-of-view was 0.8 milliradian.

The 3-5 detector has a cold spectral filter which limits the passband to the region from 3.2 to 4.77 micrometers. A six-position filter wheel with warm filters was installed in front of the 3-5 detector in order to measure the spectral content of backgrounds at various passbands within the 3.2 to 4.77 region. Figure 2.1.3 is a photograph of the filter wheel. Only four of the available six positions in the filter wheel were used for the background measurements. The passbands for these four filters were: 3.8-4.2 micrometers, 3.4-4.3 micrometers; 4.4-4.77 micrometers; and a wide band filter. When this latter filter was in position the measured spectrum was limited by the internal cold filter on the detector to the 3.2-4.77 micrometer passband. The number, sequence and dwell time for the selection of filters can be programmed for automatic operation or can be controlled manually.

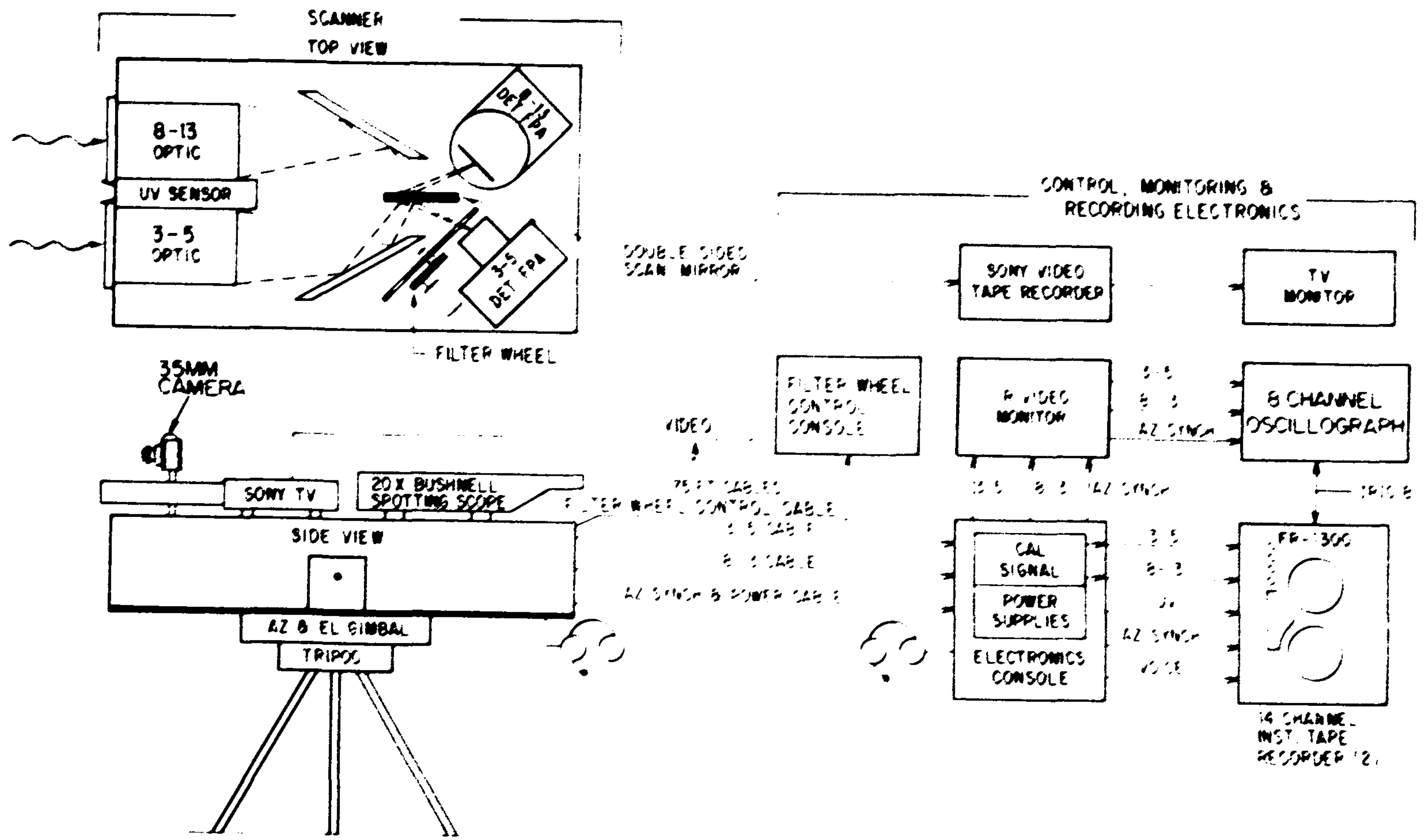

Figure 2.1... MIDAS III/UV System Block Diagram

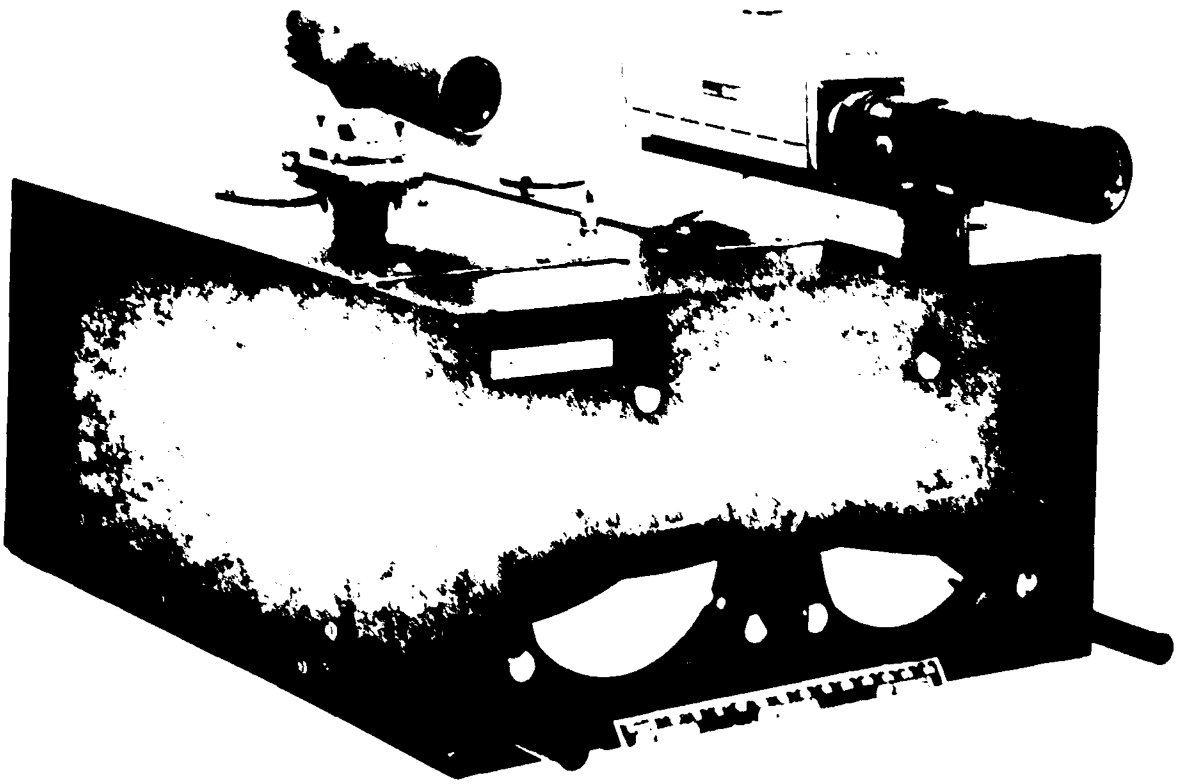

Figure 2.1.2. MIDAS III Scanner

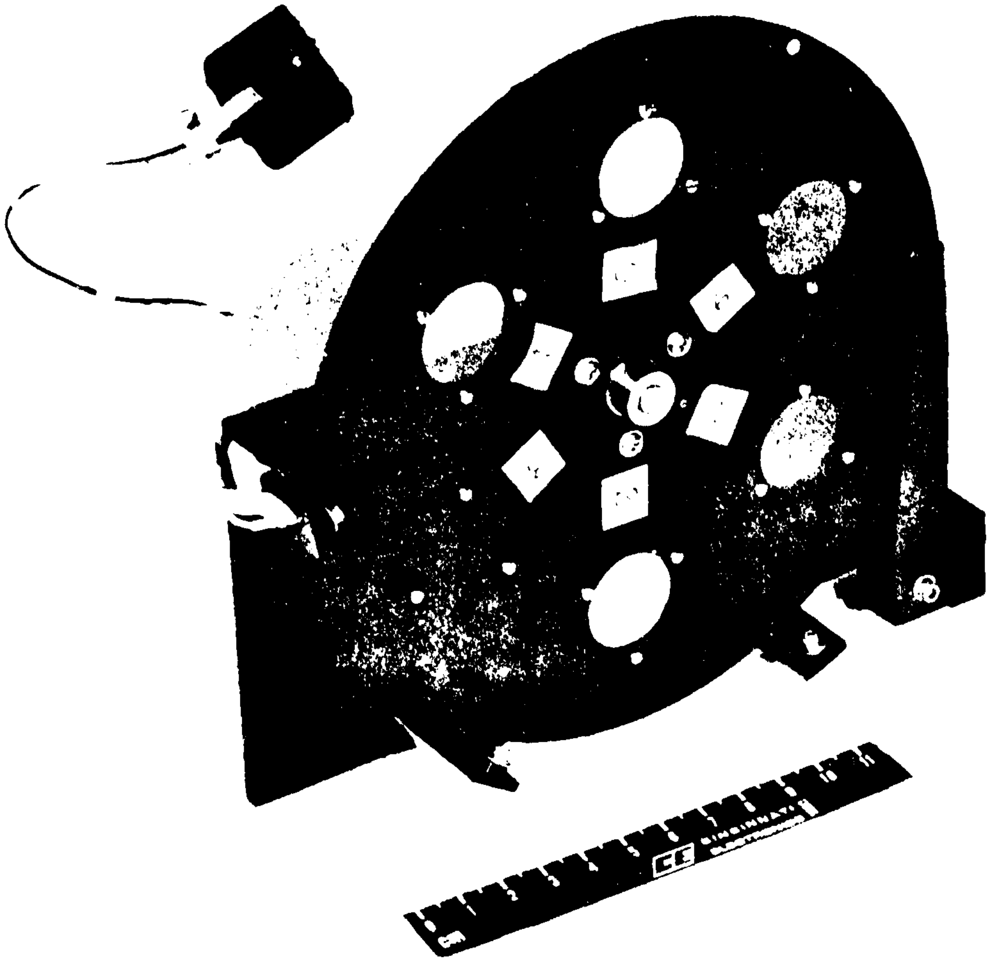

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Figure 2.1.3. Filter Wheel Assembly

The scan mirror is driven by a cam which produces a linear scan of 28 mrad from right to left in the object plane in 75 msec followed by a retrace to the original position in 25 msec. Each detector element output connects to an analog preamp/postamp channel which produces an output signal corresponding to the spatial variation of infrared irradiance across the scanned field-of-view within the instantaneous angular field-of-view of the detector element. The resolution and sensitivity parameters are shown in Figure 2.1.4.

The MIDAS III control console was located in the mobile support van next to the scanner. The console supplies power to the scanner, provides for switching, attenuation, and monitoring of the detector channels and contains a calibration signal generator for tape recorder calibration. Amplifiers for the audio channel are also provided.

The Filter Wheel control console was also located in the mobile support van. The console supplies power to the filter wheel independent of the MIDAS III system and controls filter selection and filter dwell time. Filter wheel position and various diagnostics are displayed.

2.2 DATA RECORDING AND READOUT

The data recording and readout electronics consist of a 4 trace oscilloscope for direct monitoring of channel video signals, an 8 channel recording oscillograph for permanent visible records of direct or playback signals, and two FR-1300, 14 channel instrumentation tape recorders for permanent data records. In addition there was a Sony video tape recorder and video monitor to record and display the picture from the TV camera on the scanner. All this equipment was located inside the mobile support van.

The two FR-1300 tape recorders were used in the FM mode except for the voice and IRIG time code channels which were direct mode. The 3-5 channels (A1 through A8) were recorded on channels 1 through 8 of recorder A and the 8-13 um channels (C1 through C8) were recorded on channels 1 through 8 of recorder B. On each recorder the IRIG time code, azimuth sync signal, and the voice channel were recorded on channels 12, 13 and 14 respectively. The tape channel format is tabulated in Figure 2.2.1.

A Bell and Howell 5-134 Recording Oscillograph was used for direct recording of data for immediate analysis and for later playback. The oscillograph is capable of simultaneously reproducing 6 channels of data plus IRIG time code and azimuth sync. For both on-site data monitoring and post-test strip out for data reduction, the oscillograph was run at 20 inches per second. In almost all cases a gain of 0.2 volt per inch was used.

The SLR camera is a 35 mm Pentax ME that was added to the MIDAS III system for the Key West tests. The camera was boresighted with the IR lenses so that photographic documentation of the backgrounds could be recorded simultaneously with the IR measurements. The camera has an optional red filter so that both filtered and unfiltered pictures can be taken in order to record the scene with maximum contrast. A hand held Polaroid camera was also used to obtain real time photos of the various backgrounds. Many of the pictures that are presented with the data are Polaroid shots because of various problems with the 35 mm approach, some of which were not discovered until after the test.

SYSTEM	LWIR DETECTOR	MWIR DETECTOR
SPECTRAL PASSBANDS	8–13 μm	3.2–4.8 μm
FIELD-OF-VIEW		
Azimuth	1.6° (28 mrad)	1.6° (28 mrad)
Elevation	0.8 mrad (Recorded Data) 1.5 mrad (Total FOV)	0.8 mrad (Recorded Data) 2.3 mrad (Total FOV)
RESOLUTION		
Azimuth	0.1 mrad	0.1 mrad
Elevation	0.12 mrad	0.12 mrad
FRAME RATE	10 Frames/Sec	10 Frames/Sec
ELECTRONIC BANDWIDTH	5-1900 Hz	0.05–1900 Hz
OPTICS		
SPECIFICATIONS	7" Diameter, f/3, 0.15 mrad Resolution 60% Transmission	7" Diameter, f/3, 0.15 mrad Resolution 70% Transmission
MATERIAL	4 Element Germanium	2 Germanium plus 2 Silicon Elements
DETECTOR		
TYPE	HgCdTe	InSb
NUMBER OF CHANNELS	16	24
$D^*_{\lambda p}$ (cm $Hz^{1/2}$ $Watt^{-1}$)	$2\text{-}3 \times 10^{10}$	$7\text{-}20 \times 10^{11}$
SENSITIVITY		
NEI (Watts cm^{-2})	$2.5\text{-}5 \times 10^{-13}$	$0.7\text{-}3 \times 10^{-14}$

Figure 2.1.4. MIDAS III System Parameters

RECORDER A

TAPE CHANNEL	MODE	DATA
1	FM	A1
2	FM	A2
3	FM	A3
4	FM	A4
5	FM	A5
6	FM	A6
7	FM	A7
8	FM	A8
9		
10		
11		
12	DIRECT	IRIG
13	FM	AZ SYNC
14	DIRECT	VOICE

TAPE DRIVE SPEED 7-1/2 IPS

RECORDER B

TAPE CHANNEL	MODE	DATA
1	FM	C1
2	FM	C2
3	FM	C3
4	FM	C4
5	FM	C5
6	FM	C6
7	FM	C7
8	FM	C8
9		
10		
11		
12	DIRECT	IRIG
13	FM	AZ SYNC
14	DIRECT	VOICE

TAPE DRIVE SPEED 7-1/2 IPS

Figure 2.2.1. Tape Recorder Channel Format

3.0 SYSTEM CALIBRATION

Radiometric calibration of the MIDAS III System was accomplished by measuring the response of the system to a source of known temperature, emissivity, and angular size. The calibration was done in the Cincinnati Electronics Corporation optical lab on a 16-inch Davidson reflecting collimator. An Infrared Industries blackbody set at 200°C was used as the infrared source. This source has an emissivity of 0.99 ± 0.01. The temperature was monitored by means of a thermocouple located in the cavity block. The measured temperature is believed accurate to ± 1.0°C.

Since the calibration needed is the large target radiance calibration rather than the point source irradiance calibration, an extended target should be used as a source. However, a 200°C large source will saturate the electronics. For this reason, a 1/20 mrad point source precision aperture was used and the voltages measured were multiplied by the ratio of the large target signal to the 1/20 mrad target signal measured at a lower temperature where saturation did not occur. The reason that this measurement was not used as the actual large target calibration is that the low temperature could not be measured or controlled as accurately as the 200°C temperature. However, the ratios measured are accurate regardless of the actual temperature of the source. The ratio was found to be 12.30 for the 3-5 μm channels and 17.67 for the 8-13 μm channels.

The output signal pulse from the 1/20, 200°C source was observed on an oscilloscope and the difference in the signal voltage between the hot target and the ambient temperature aperature disk was recorded. The results were multiplied by the above ratios and averaged over the 8 channels and are shown in Figure 3.1.

The next step in the system calibration is to determine the radiance difference of the target for each filter. The effective radiance difference, ΔL eff (λ_p), at wavelength λ_p is calculated from the equation,

$$\Delta L_{eff}\ (\lambda_p) = \rho_B \int \tau_A\ (\lambda)\ \frac{\tau_F\ (\lambda)}{\tau_F\ (\lambda_p)}\ \frac{R_S\ (\lambda)}{R_S\ (\lambda_p)} \left| L_\lambda\ (T_{BB}) - L_\lambda\ (T_L) \right|\ d\lambda$$

where ρ_B is the reflectance of the collimator mirror system

$\tau_A\ (\lambda)$ is the spectral atmospheric transmission over the 21 foot collimator path length

$\tau_F\ (\lambda)$ is the spectral transmission of the system filter at wavelength λ

λp is a reference wavelength

SPECTRAL BAND (μm)	PEAK WAVELENGTH λ_p (μm)	VOLTAGE DIFFERENCE 200°C LARGE TARGET NO ATTENUATION (V)	RADIANCE DIFFERENCE ΔL_{eff} 200°C TARGET, 24°C AMBIENT $\left(\frac{w}{cm^2 \cdot ster}\right)$	CALIBRATION FACTOR (RADIANCE DIFFERENCE PER VOLT) $\left(\frac{w}{cm^2 \cdot ster \cdot V}\right)$
3.2–4.77	4.5	13.40	6.953×10^{-3}	0.519×10^{-3}
4.4–4.77	4.5	7.69	3.082×10^{-3}	0.387×10^{-3}
3.8–4.2	4.0	4.00	2.243×10^{-3}	0.561×10^{-3}
3.4–4.3	4.0	6.78	3.505×10^{-3}	0.517×10^{-3}
8–13	10.0	32.14	15.95×10^{-3}	0.496×10^{-3}

Figure 3.1. Calibration Factors

$R_S(\lambda)$ is the basic system spectral responsivity in centimeters squared volts per watt without the filter,

$L_\lambda(T_{BB})$ is the blackbody spectral radiance in watts per square centimeter per steradian per micrometer at the blackbody temperature T_{BB},

and $L_\lambda(T_L)$ is the blackbody spectral radiance at the laboratory temperature T_L.

The spectral atmospheric transmission was calculated for the 21 foot Davidson collimator path length. The spectral transmission curves for the 4 filters used during the test were measured with a Beckman IR-4 Spectrophotometer. The basic system spectral responsivity, $R_S(\lambda)$, was determined by using a series of spike filters covering the system passband in conjunction with the collimated blackbody source.

The overall system response (basic radiometer plus spectral filter) for the 3-5 channel is shown in Figures 3.2 through 3.5 for the various filters used. Filter No. 1 was broadband uncoated sapphire for optical path compensation so that the overall system response is the same as the basic system response with no filter. The overall system response for the 8-13 channel is shown in Figure 3.6.

The spectral atmospheric transmission, system and filter spectral curves, and blackbody temperature were used in a previously developed computer program to calculate $\Delta L_{eff}(\lambda_p)$ for the various filters according to the above equation. These radiance difference values were then divided by the average measured signal voltage for all the channels in the 3-5 µm array. Figure 3.1 also gives the radiance differences and the calibrated effective radiance difference per volt for each filter in the 3-5 µm detector and for the 8-13 µm detector.

Although field calibration measurements were made in order to check system operation and atmospheric effects, the lab calibrations were used in data reduction.

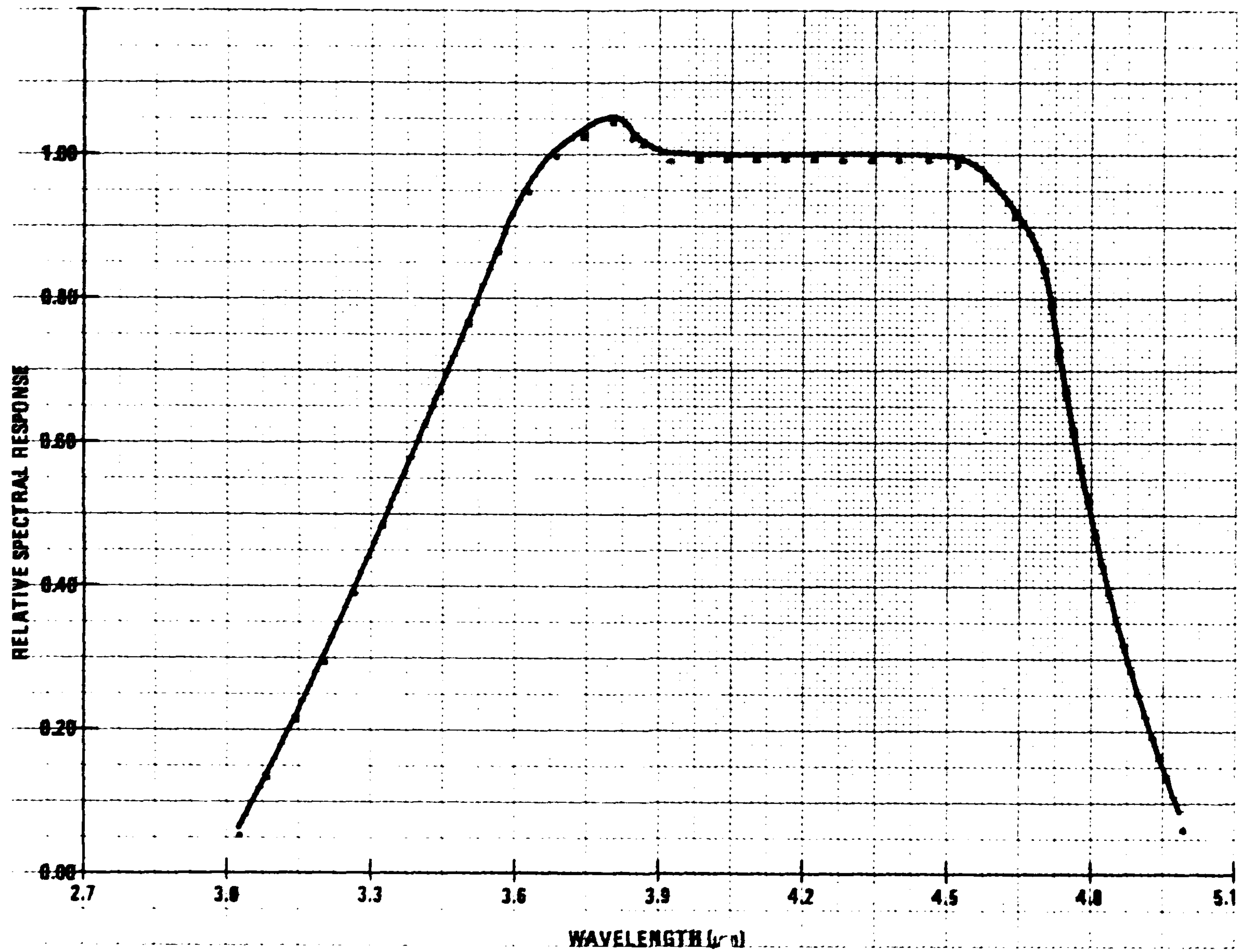

Figure 3.2. System Relative Spectral Response - Filter No. 1 (3.2-4.77 μm)

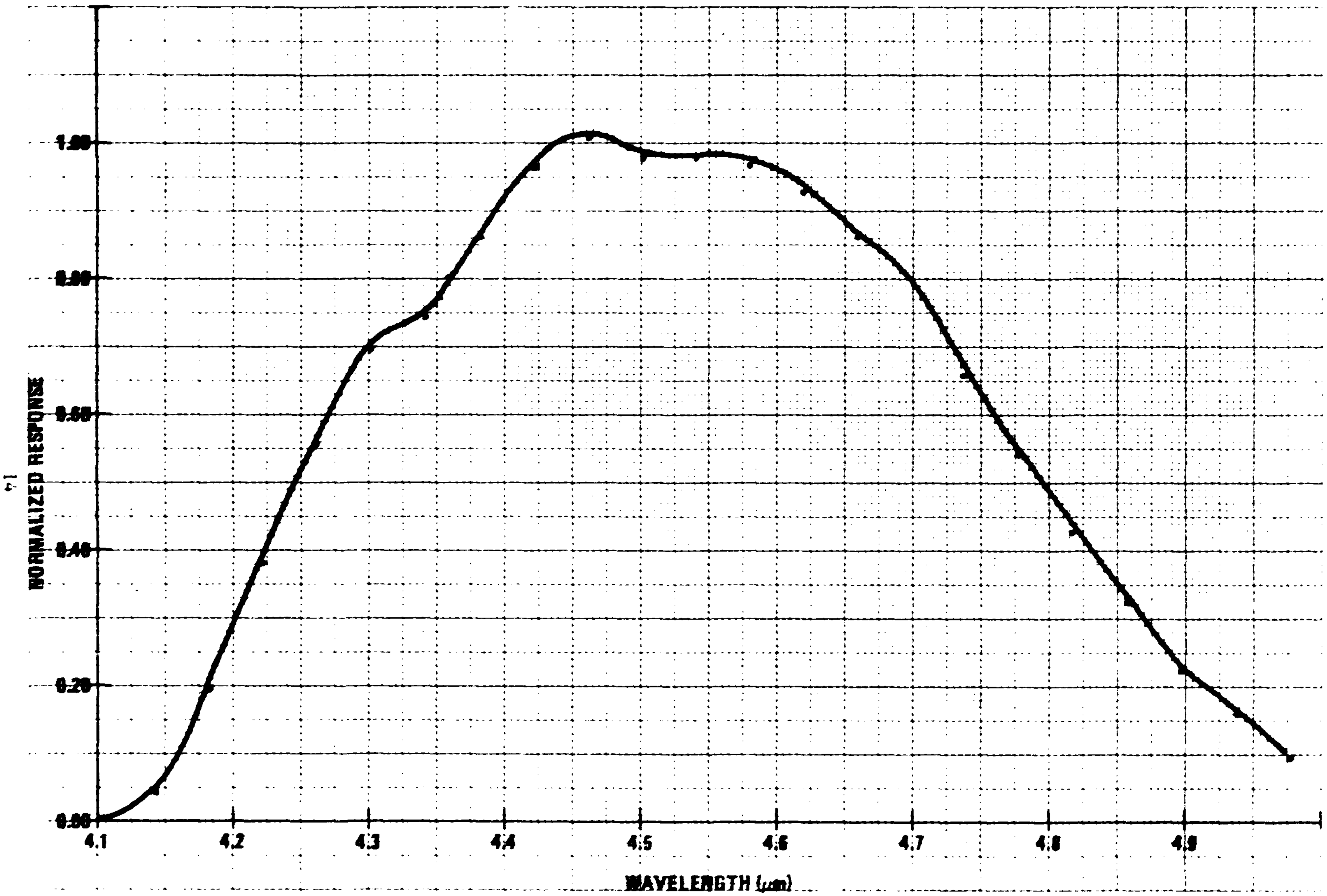

Figure 3.3. System Relative Spectral Response - Filter No. 2 (4.4-4.77 μm)

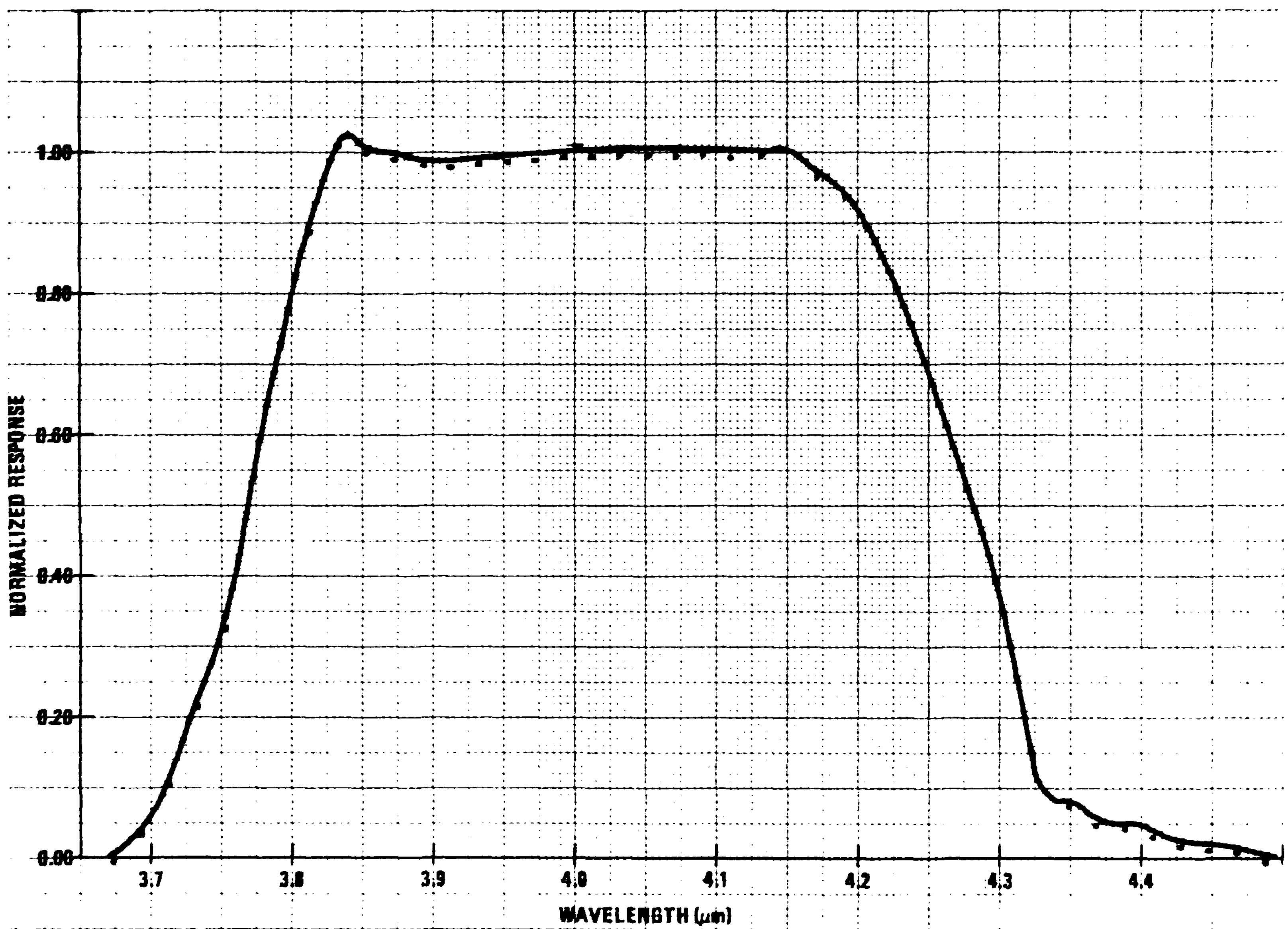

Figure 3.4. System Relative Spectral Response - Filter No. 5 (3.8-4.2 μm)

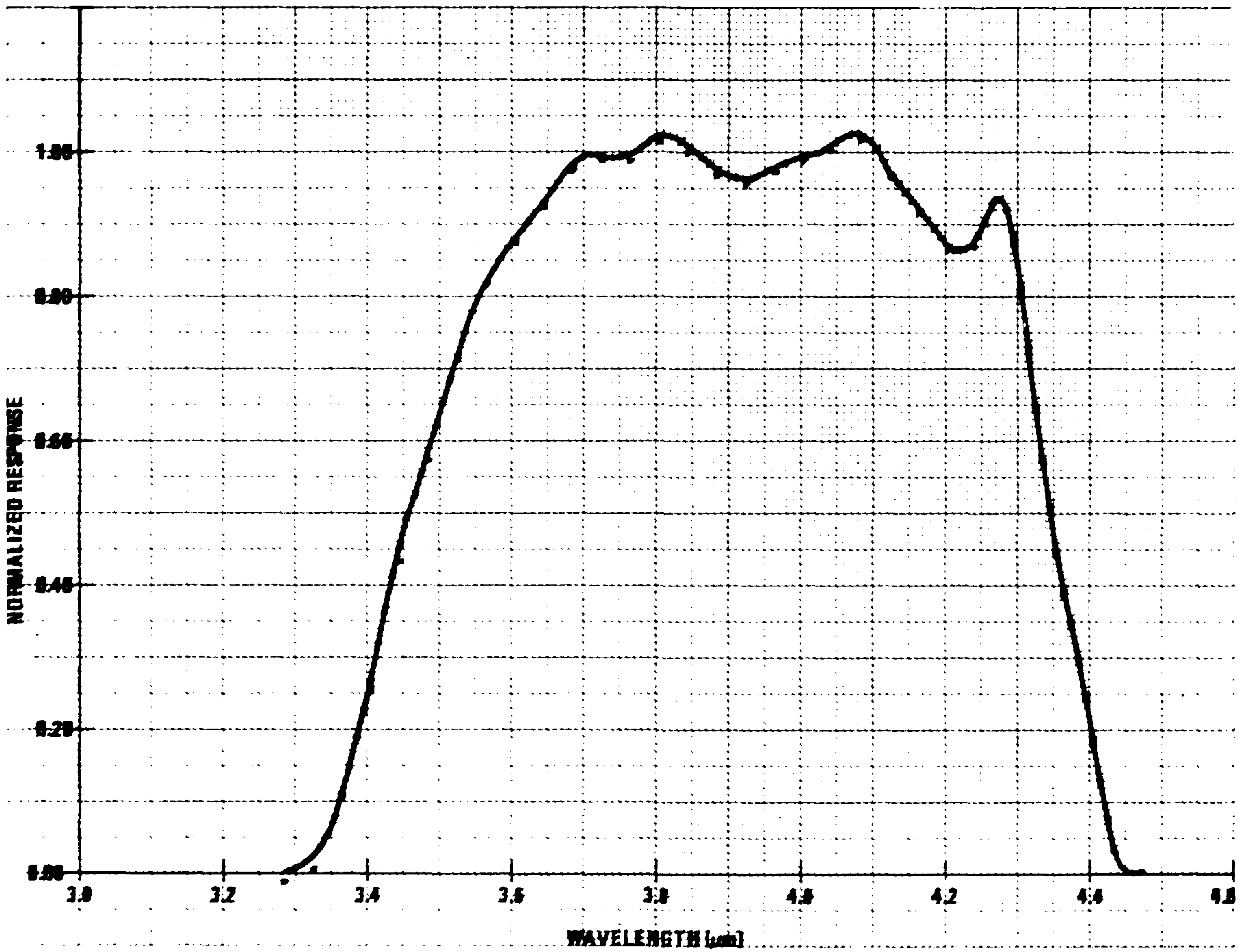

Figure 3.5. System Relative Spectral Response - Filter No. 6 (3.4-4.3 μm)

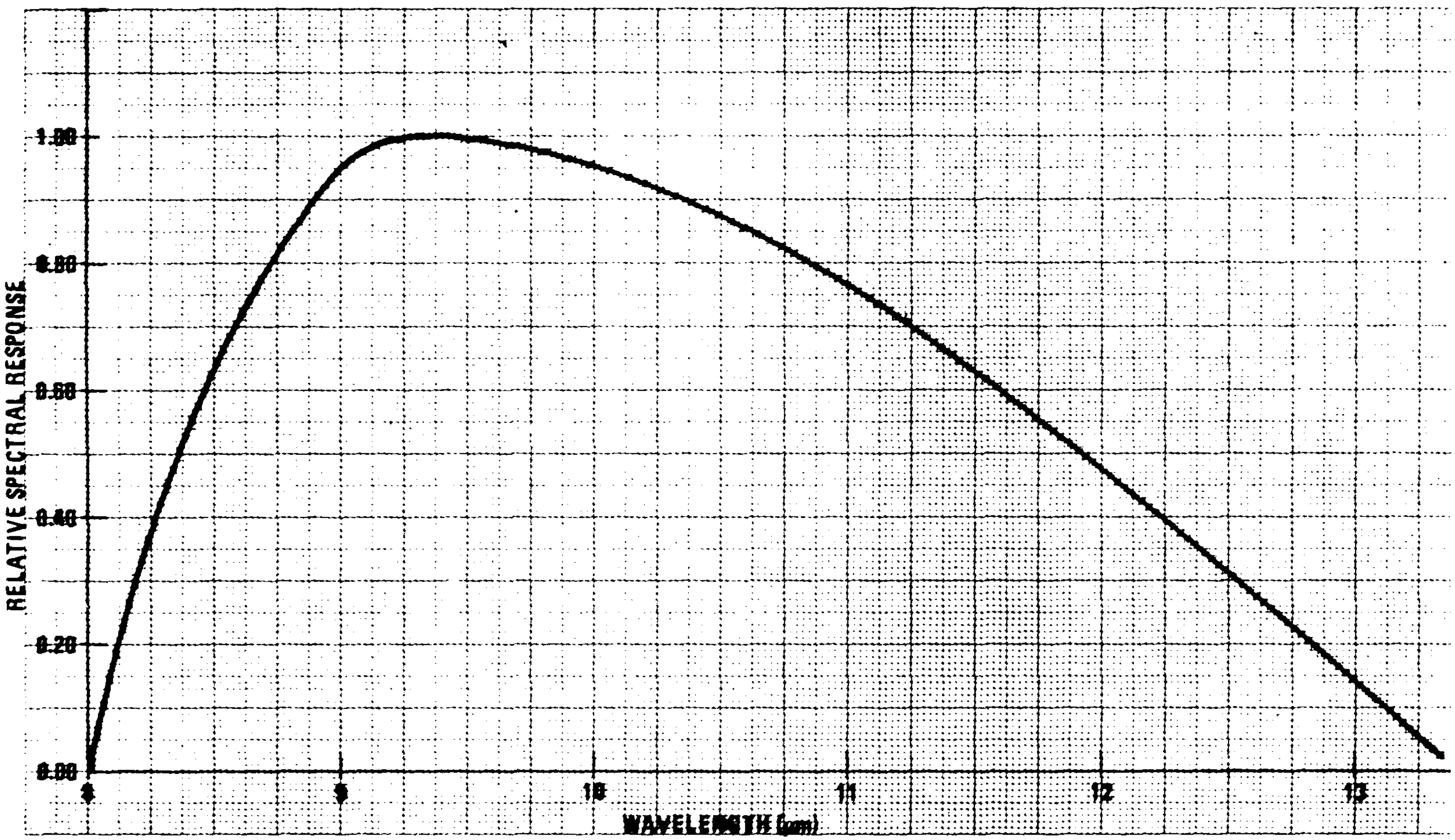

Figure 3.6. 8-13 System Response

4.0 TEST SITE DESCRIPTION

The cloud background measurements were taken at a site which was located at the northern tip of Fleming Key which is adjacent to Key West. At the time of the tests the site was located on an Army Hawk Missile Base which has since been moved to another location. Figure 4.1 is part of nautical chart which shows Key West, Fleming Key, the test site and the depth of the water surrounding the keys. Figure 4.2 is an aerial photograph of the same location.

The MIDAS system had a 240-degree unobstructed view of the sky, horizon and sea clockwise from 270 degrees through 150 degrees. The remaining 120 degrees was obscurred by bunkers on the missile site and by adjacent equipment. Figure 4.3 is a photograph from the top of one of the bunkers looking east. The Navy administrative trailer is located to the right. On the left of the Navy trailer is the GE/SPAR trailer with the IRST system. Next to that is the Cincinnati Electronics van and the MIDAS system is mounted on a tripod next to the van.

A blackbody was located 250 feet from the MIDAS system at a bearing of 140 degrees. The blackbody was a large area source, which was one foot square. Next to the source was a large plate at ambient temperature. Thermocouple leads were attached to the blackbody and reference in order to check the system calibration at periodic intervals during the test program.

The MIDAS system and the IRST were both aligned with one of the channel markers which was located nominally at zero degrees. There was no parallelax error in this alignment since both systems were virtually in line at a zero-degree bearing.

The test location provided a maritime environment with temperatures between 79°F and 84°F and relative humidity between 53 and 82 percent. The surface visibility was in excess of 7 statute miles for most of the data. The instrument that was used to measure visibility had a maximum range of 7 miles and this value was recorded whenever the visibility was equal to or greater than 7 miles. The environmental data was all recorded at the naval air station on Boca Chica Key. The distance between the test site and the environmental test instruments was approximately 5-6 nautical miles.

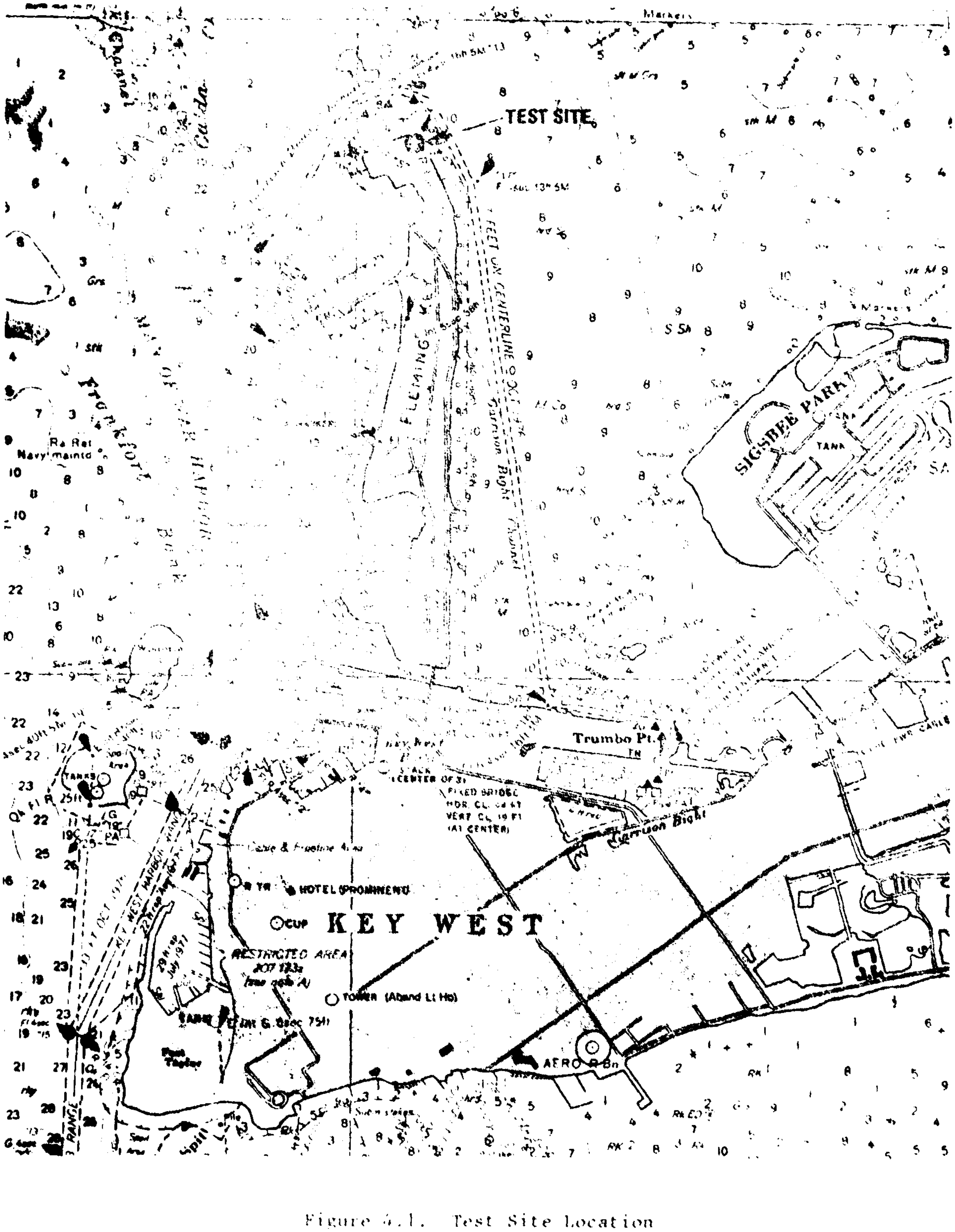

Figure 4.1. Test Site Location

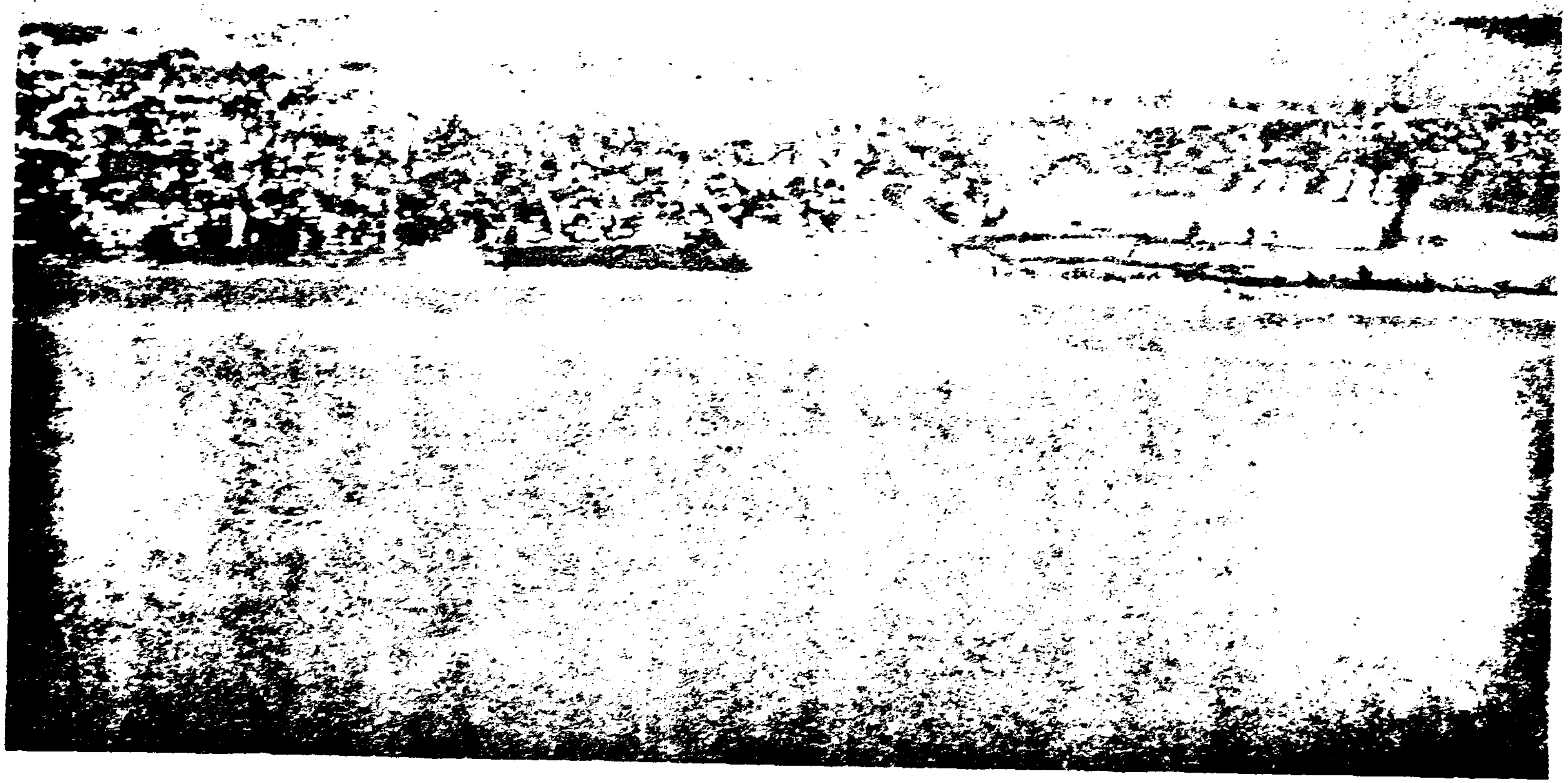

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Figure 4.2. Aerial View of Test Site

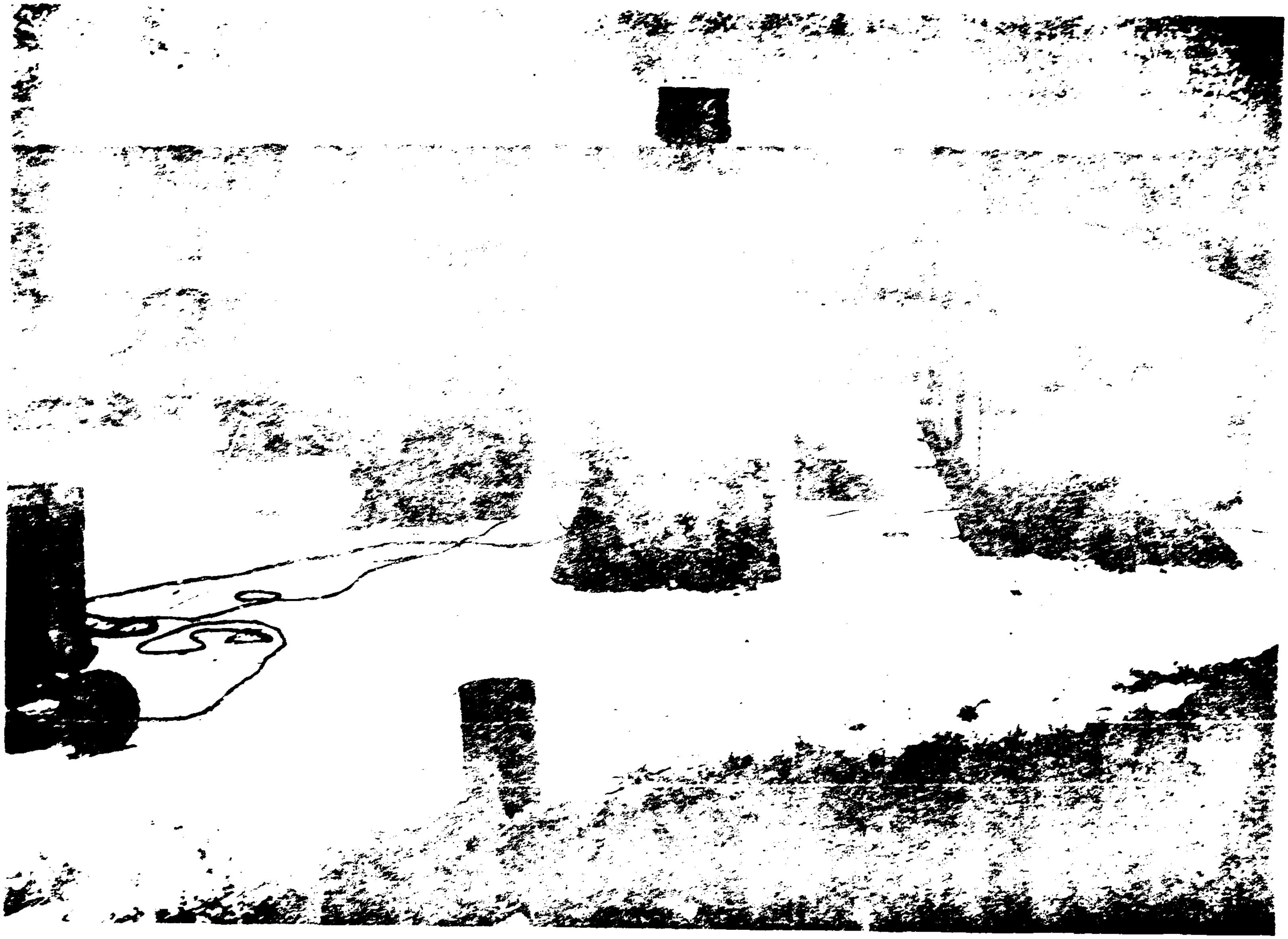

Figure 4.3. View From Test Site

5.0 BACKGROUND MEASUREMENTS

The purpose of the Background Measurements phase of the contract was to obtain radiometric data on various types of clouds. The MIDAS system was scanned across different cloud formations and cloud/sky interfaces at different times of the day and at different angles with respect to the sun. The system was stopped and data was recorded whenever clouds that had significant structure were encountered. At times the GE/SPAR IRST system would indicate a large number of clutter points at a certain position. The MIDAS system would then be aligned with the coordinates of this clutter position and the data was recorded when significant structure was evident.

Structure in the 8-13 micrometer band was almost non-existent for all of the daytime data whereas there was a lot of structure in the 3-5 micrometer band. As a result, all of the daytime data that is reproduced in this report is 3-5 micrometer data. The evening and nighttime data has much more structure in the 8-13 micrometer band than in the 3-5 band. Hence the data that is reported for the nighttime runs include the 8-13 spectral band.

The 3-5 data was recorded directly on the recording oscillograph whereas the 8-13 data was recorded on the tape recorders first and later played back and recorded on the oscillograph. Therefore, the 8-13 data has a small amount of additional noise when compared with the 3-5 data.

During most of the tests the clouds were moving fairly rapidly and/or were changing shape and composition. As a result sequential data runs with different 3-5 band filters do not always represent the same scene. Most of the time the MIDAS system was moved in order to track the same position in a moving cloud. However, there were times when the shape of the cloud changed radically from the beginning of a measurement to the end. Thus, comparisons among the 3-5 spectral runs should be made with caution. Comparisons between the 3-5 and 8-13 bands should also be made with caution because the 8-13 graphs that are presented in this report are not necessarily coincident in time with the respective 3-5 graphs. This is a result of the fact that 8-13 data was taken at night when the IRIG time code generator of the IRST system was shut down. Therefore, no time code was available on the recorded data and corresponding frames of 3-5 and 8-13 data could not be identified.

Data for thirty-three different background targets are included in this report. This sampling represents the worst case conditions in terms of structured backgrounds. Figure 5.1 lists the thirty-three background targets and the pertinent data for each of the targets. Most of the data, such as time, bearing and meteorological conditions, are self-explanatory. The last column, entitled "IRST Clutter" required some explanation. The GE/SPAR IRST system was located next to the MIDAS system. At times the IRST would indicate a fair number of clutter points at some location. The MIDAS system would then be pointed toward the same location in the sky to measure and record the

TARGET NUMBER		DATE	TIME	TARGET ELEVATION (degrees)	TARGET AZIMUTH (degrees)	SUN TO TARGET ASPECT (degrees)	TEMP. (°F)	REL. HUMIDITY (%)	VISIBILITY (statute mi.)	IRST CLUTTER
2		1 May	1600	7.44	17	96	[illegible]	58	≥ 7	
5	(sun glint)	2 May	0947	-0.45	[illegible]	[illegible]	81	65	≥ 7	
7		2 May	1015	4.9	60	[illegible]	81	65	≥ 7	
8		2 May	1025	10.3	90	47	81	[illegible]	≥ 7	
9		2 May	1032	[illegible]	40	32	81	62	≥ 7	X
11		3 May	1015	7.2	120	52	81	65	≥ 7	X
14		3 May	1340				82	62	≥ 7	
19	(water tower)	4 May	0944		124		83	59	≥ 7	
21		4 May	1404				84	53	≥ 7	
22		4 May	1430	5.6	93	104	83	58	≥ 7	
24		4 May	1448	10.4	62	102	84	58	≥ 7	
27		4 May	1535				82	58	≥ 7	
28		4 May	1542	9.1	[illegible]	[illegible]	82	[illegible]	≥ 7	
31	(microwave tower)	5 May	0910	1.0	[illegible]	45	81	62	≥ 7	
32		5 May	0925	1.9	84	46	82	62	≥ 7	
33	(sun glint)	5 May	0930	-0.15	87	31	82	62	≥ 7	
35		5 May	1015	9.46	103	46	83	60	≥ 7	
36		5 May	1235	9.6	10	44	84	60	≥ 7	
37		[illegible] May	0924	4.6	[illegible]	36	81	72	≥ 7	
38		[illegible] May	0931	4.6	[illegible]	38	81	72	≥ 7	
39		[illegible] May	0943	24.7	3	71	82	72	≥ 7	
40		[illegible] May	1005	4.9	[illegible]	49	82	72	≥ 7	
41		[illegible] May	1030	13.0	[illegible]	40	82	59	≥ 7	
42		[illegible] May	1035	[illegible]	[illegible]	[illegible]	82	59	≥ 7	
43	(wide az scan)	[illegible] May	1050	[illegible]	[illegible]		82	66	≥ 7	X
45	(across horizon)	[illegible] May	1330		[illegible]		83	64	≥ 7	X
46	(above horizon)	[illegible] May	1332		[illegible]		82	64	≥ 7	
47	(below horizon)	[illegible] May	1334		[illegible]		84	63	≥ 7	
48		5 May	1650	15.2	[illegible]	122	84	62	≥ 7	
49		5 May	2015	14.4	123		80	73	3	
51		8 May	2031	24	[illegible]		79	73	3	
52		9 May	1037	4.3	[illegible]	[illegible]	83	66	≥ 7	
[illegible]		10 May	0932	11.4	114	[illegible]	84	55	≥ 7	

Figure 5.1. Key West Background Data

spectral characteristics of that particular clutter region. Targets of this type are indicated with an "X" in the last column. All other targets were selected independently of the IRST system.

A few of the targets were different from the majority of structured cloud background. Target 43 is a wide scan in which the MIDAS system was panned across a wide azimuth field to obtain data on the variability of the background. Targets 45, 46 and 47 are scans near the horizon which were recorded to measure the sky/sea contrast levels. Target 45 crosses the horizon during the horizontal scan, going from the sky to the sea as the scan moves from left to right. Target 46 is a scan entirely in the sky just above the horizon and target 47 is a scan entirely in the sea just below the horizon. Target 31 is a scan across a microwave tower against a sky background. Target 19 is a scan across a water tower with a sky background. The target is included because it is an interesting example of contrast reversal between the 3-5 and 8-13 spectral bands. The target shows negative contrast with respect to the sky in the 3-5 spectral band and positive contrast with respect to the sky in the 8-13 spectral band. Targets 5 and 33 are scans of sun glint off the ocean surface. When recording cloud targets 27, 28 and 35 the clouds were tracked with the radiometer. All other cloud targets were recorded with the radiometer stationary.

The spectral data for each of the thirty-three targets is shown in Appendix 1. The figures are numbered according to the target numbers. Each target has a summary of the test parameters along with a picture of the scene that was measured. The picture has a black line on it which defines the area that was scanned by the MIDAS system. A set of arrows indicates the position of the black line.

Following each data/picture sheet is a set of analog graphs. The spectral band for each series of graphs is listed at the top of the graph. Six scans are arranged vertically on each graph. The six scans are the analog outputs from the first six elements of the detector. Therefore, the six traces represent scans in object space that are separated by 0.1 milliradian in the elevation direction. The total vertical field covered by the six scans is 0.6 milliradian. The horizontal traces are backward when compared to object space. Thus the traces from left to right represent scans from right to left in the pictures. The horizontal field covered by each scan is 1.6° or 28 milliradians as indicated by the scale at the bottom of the graphs. Alternate scans in the vertical direction are staggered 0.5 milliradian in the horizontal direction because the corresponding detector elements are staggered. The vertical dimension on each graph is the effective radiance difference in watt/sq. cm.

6.0 RECOMMENDATIONS

It is recommended that additional work be done in two separate areas - dc restoration and data analysis.

6.1 DC RESTORATION

In the existing MIDAS system, some of the electronic bandpass filters have a cuton at 30 Hz in order to minimize the 1/f detector noise and increase sensitivity. This ac coupling is acceptable for point target measurements or area measurements with reference sources closely contained in the same scan line, but in order to measure accurately the absolute amplitude of area target or background radiation as well as the radiance contrast, for comparison with analytical models or use in future IR systems designs, the absolute or dc level of the background radiation across the field-of-view has to be recorded.

One solution for preserving the background level is to lower the filter cuton frequency so a dc level (uniform background) can be maintained across one scan of the field-of-view. To get a negligible level droop across a single scan requires a 0.1 Hz cuton frequency. This introduces more 1/f noise. After several scans this level will eventually decay to zero due to the finite time constant on the coupling between the preamplifier and postamplifier. This decay can be eliminated by injecting optically a reference signal level during the 25% retrace time of the scan mirror. This technique solves the long term droop by "dc restoring" while also providing a known reference level each frame which can be used to precisely calibrate the dc or any other target or background voltage level.

Several methods of injecting a reference signal have been examined and one technique has been selected. This concept uses an external shutter in conjunction with an internal chopper. Cincinnati Electronics recommends that the MIDAS system be modified for dc restoration by adding the shutter and chopper and by modifying the detector electronics that have a cuton at 30 Hz.

6.2 DATA ANALYSIS

The data that is presented in this report is just a small sample of the data that is available on tapes and oscillograph charts. In order to greatly increase the usefulness of this data it should be reduced and analyzed. The paragraphs below outline the specific tasks that should be performed with the data.

6.2.1 STANDARD FORMAT BACKGROUND TAPES

The data should be put on a formatted IBM tape using CE's in-house IBM 370-138 computer in order to make the Key West background data available as standard reference material for other studies.

6.2.2 (3.8-4.2)/(4.4-4.8) IRRADIANCE RATIOS

There is sufficient data in the 3.8-4.2 μm and 4.4-4.8 μm bands to characterize irradiance ratios between those bands for backgrounds such as clouds, terrain, and ocean measured at Key West. As part of the total industry effort to develop long-range search and track systems, several groups have developed techniques to compute the theoretical values of such color ratios for spectral bands similar to those mentioned above. The predictions are made for targets and for backgrounds using the somewhat limited amount of cloud background data previously available. System design methods could be improved if the predictive capability were verified by a larger amount of color ratio data taken from background measurements such as Key West data.

6.2.3 THRESHOLD CROSSINGS vs. THRESHOLD LEVEL AND TIME

False alarms in infrared warning systems may occur because of a threshold level setting which is too low for the background level. Generally, analysis of a system's false alarm rate can be done in terms of threshold crossings per unit time and fraction of time the threshold is crossed for a given threshold setting and type of background. Reduction of the MIDAS-Key West background data to these formats would provide a useful data base for analysis of the performance of IR search systems with respect to threshold crossing rates for several spectral regions and selected electronic bandpasses.

6.2.4 VERTICAL FIELD-OF-VIEW EFFECTS

For system design, the effect of vertical (elevation) field-of-view is important. We have data on eight separate vertically arranged channels using MIDAS. By summing the outputs of the channels in various combinations, we can determine the effect of elevation FOV or detector size on the background results. Since the detector has vertically staggered elements, allowance must be made for time delay in azimuth. The results could be useful in detector configuration design in other systems.

6.2.5 SUNGLINT IN THE 3-5 μm AND 8-12 μm REGIONS

One source of false alarms is sunglints from water. IR sunglint data is complicated since the moving waves, which act as reflectors, follow complicated trajectories with time. However, we can determine from the data whether simultaneously viewed sunglints are more intense in the 3-5 μm or 8-12 μm windows, compared to the expected values of target signals in those same windows.

6.2.6 DAY/NIGHT COMPARISON

Some of the MIDAS-Key West data was taken during the day and some at night. Since many systems are required to perform both day and night, a comparison of background characteristics at both times would show how a given system design might be expected to perform in this regard.

7.0 MIDAS REFERENCES

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2. R.J. Day and R.L. Shaver, "MIDAS II/UV Field Test at White Sands Missile Range (U)", CE Corp CTR-75-0002, Final Report Contract F33615-73-C-4089, July 25, 1975, Secret.

3. R.J. Day, R.L. Shaver, "Aerodynamic Infrared Target Signature Measurements with the MIDAS II Sensor at Holloman AFB (U)", CE Corp CTR-75-0004, Final Report Contract F29651-75-90186, 13 Jan. 76, Confidential, AFAL-TR-76-30.

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8. A.G. Geiser, "MIDAS III Infrared Measurements of AIM-4A, AIM-4D, and AIM-9B Missiles for Holloman AFB (U)", CE Corp TR-77-0017, Final Report Contract F29651-77-90089, Confidential.

9. L.A. Williams, A.G. Geiser, R.W. Englert, C.E. Dippel and P.H. Malone, "The Effect of BAckground Obscuration on MIDAS Data", CE Corp 30-7030N, 14 December 1977.

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11. A.G. Geiser and L.A. Williams, "Multispectral Infrared Data Acquisition System (MIDAS III) Infrared Measurements at San Nicolas Island for Optical Signatures Program (OSP III) (U)", 17th Symposium on IRCM, IRIS, April 1979, Confidential.

12. A.G. Geiser, "IR Measurements for Optical Signatures Program (OSP III) (U)", Volumes I and II, CE Corp CTR-79-0004, Final Report Contract N00123-76-C-1918, 12 April 79, Secret.

13. A.G. Geiser, "Measurements of AIM-9B/Have Cargo and AIM-7E Missile Aerodynamic Surface Heating (U)", CE Corp CTR-79-0015, Final Report Contract F29651-79-C-0037, 30 October 1979, Secret.

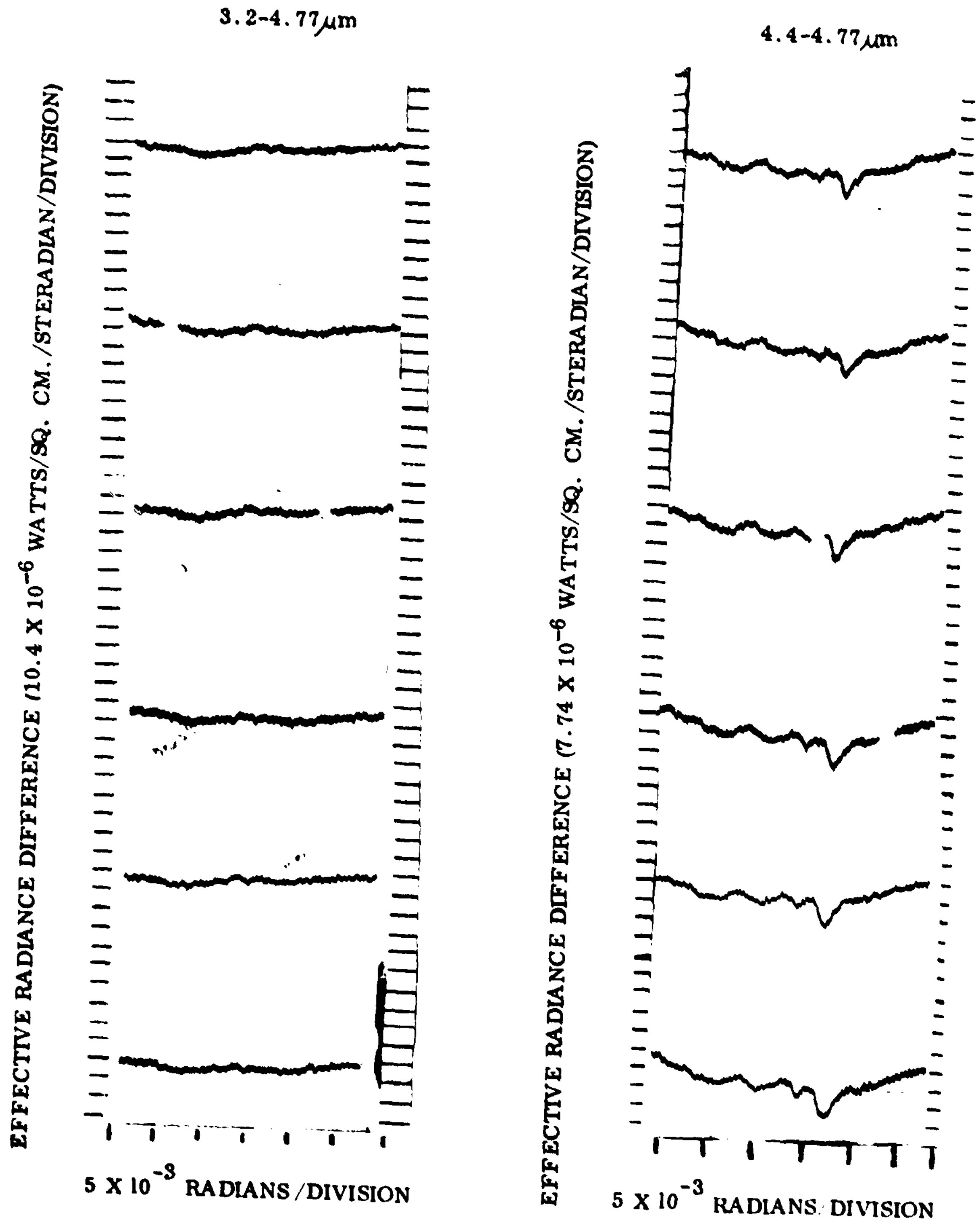
APPENDIX I

The following pages contain the data on cloud backgrounds for 33 different targets.

TARGET 2

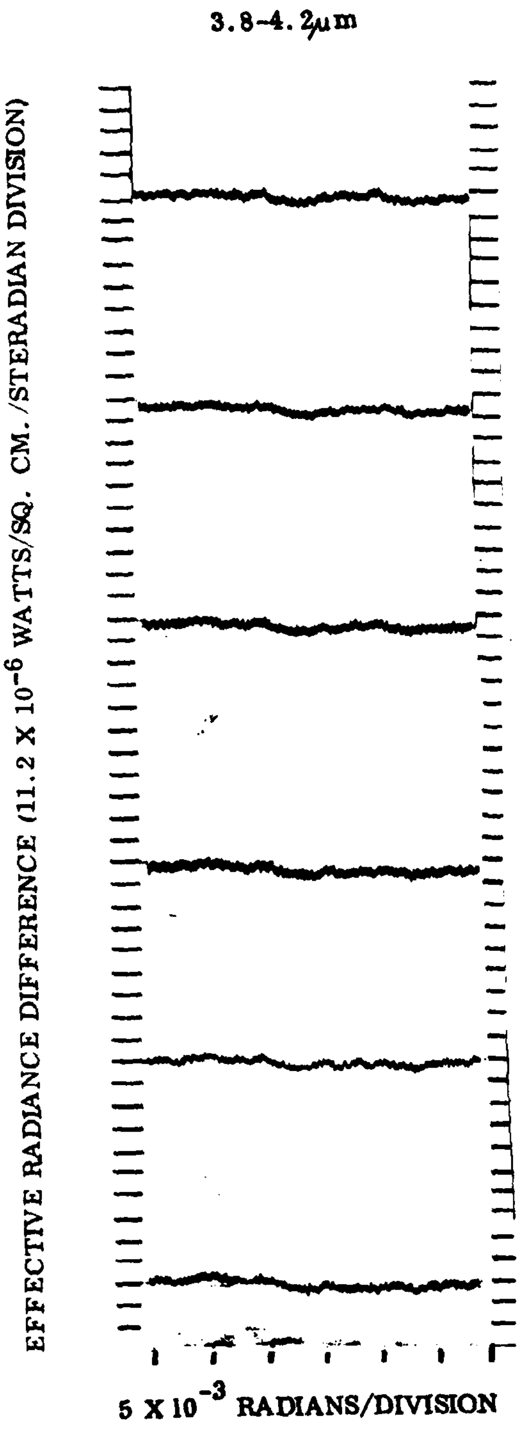
DATE: 1 MAY 1979
TIME: 16:00
TEMPERATURE: 78^{o}F
RELATIVE HUMIDITY: 56%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 17^{o}
TARGET ELEVATION: 7.4^{o}
SUN TO TARGET ASPECT ANGLE: 96^{o}

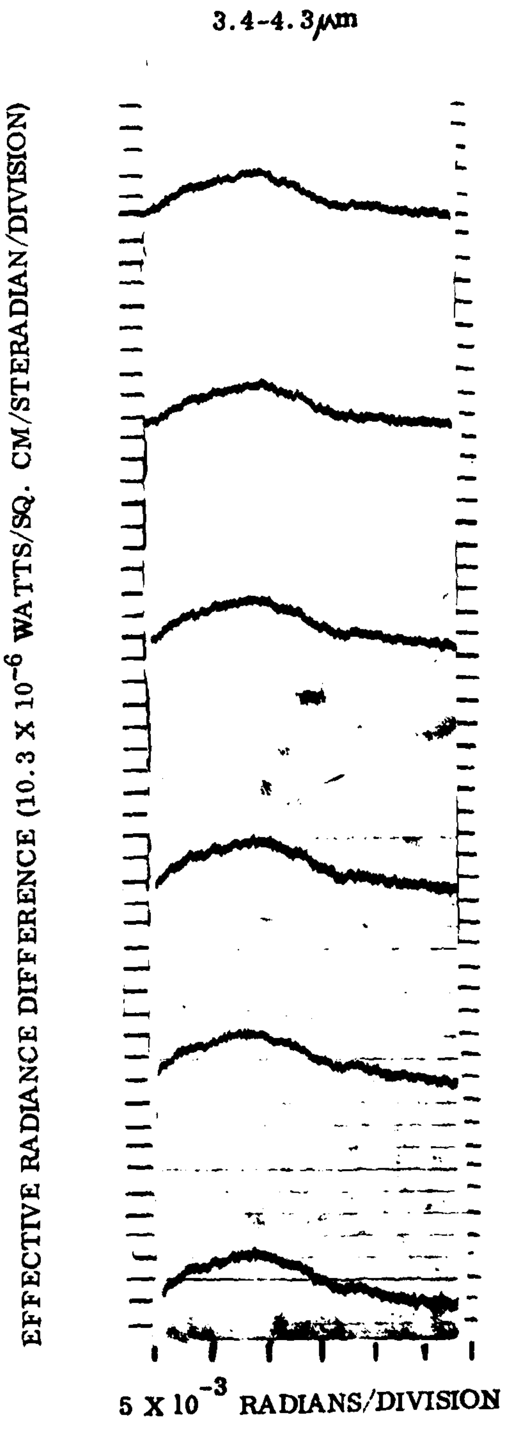
TARGET 2



3.2-4.77µm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION
4.4-4.77µm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

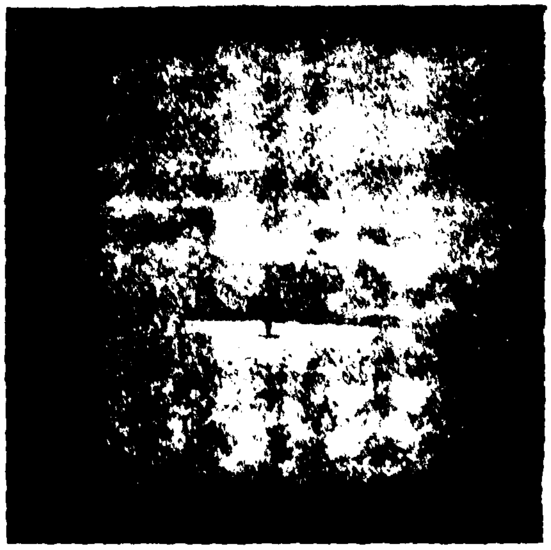
TARGET 2


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

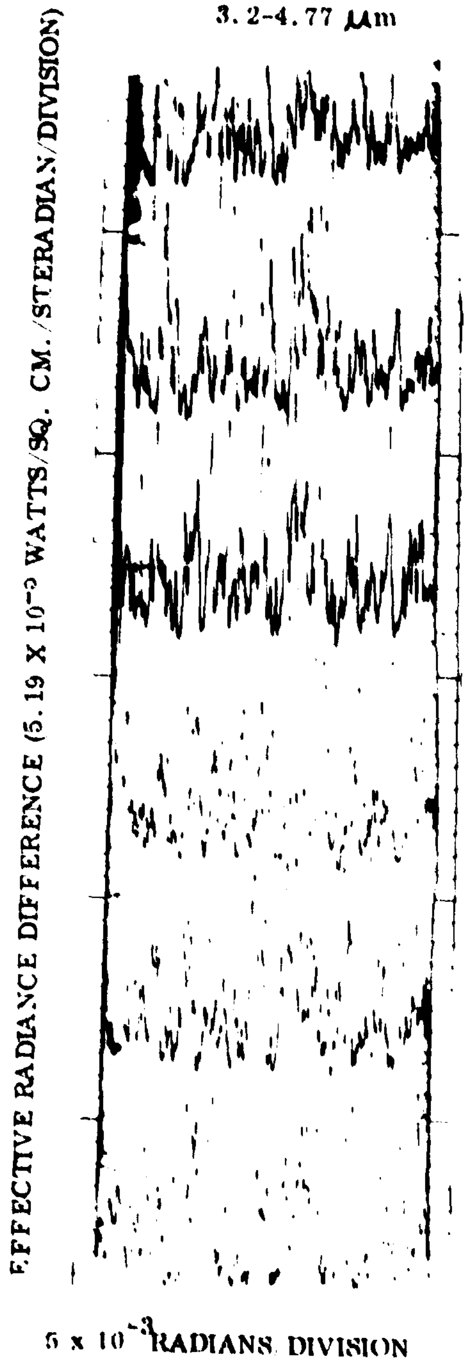

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 5

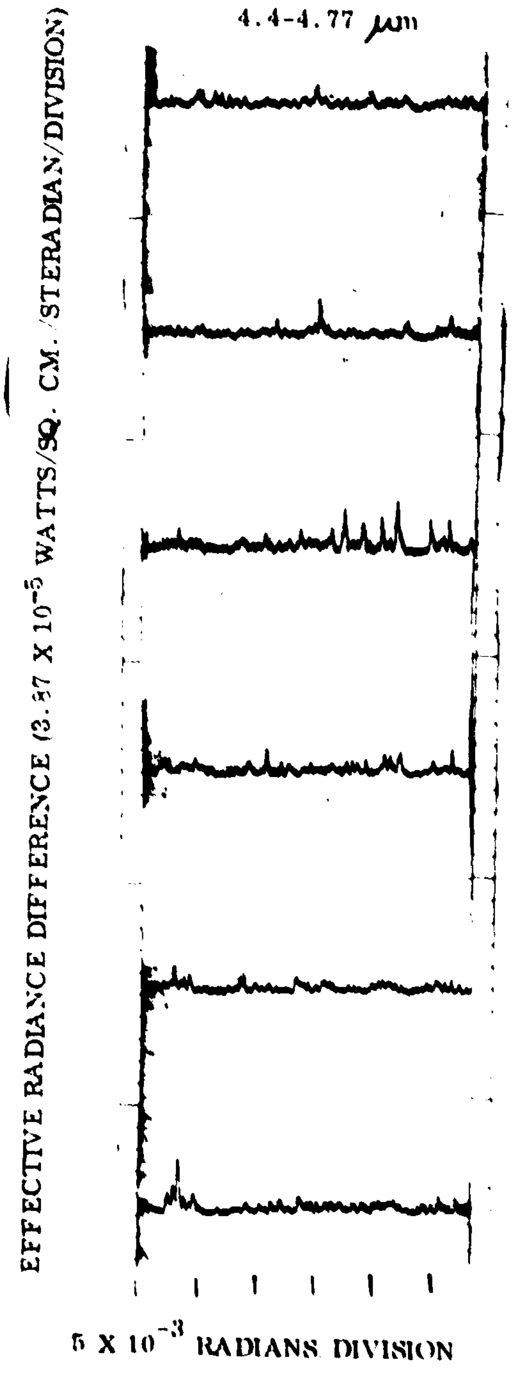
DATE: 2 MAY 1979
TIME: 9:47
TEMPERATURE: 81°F
RELATIVE HUMIDITY: 65%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 86°
TARGET ELEVATION: -0.4°
SUN TO TARGET ASPECT ANGLE: 86°
SOLAR GLINT



TARGET 5



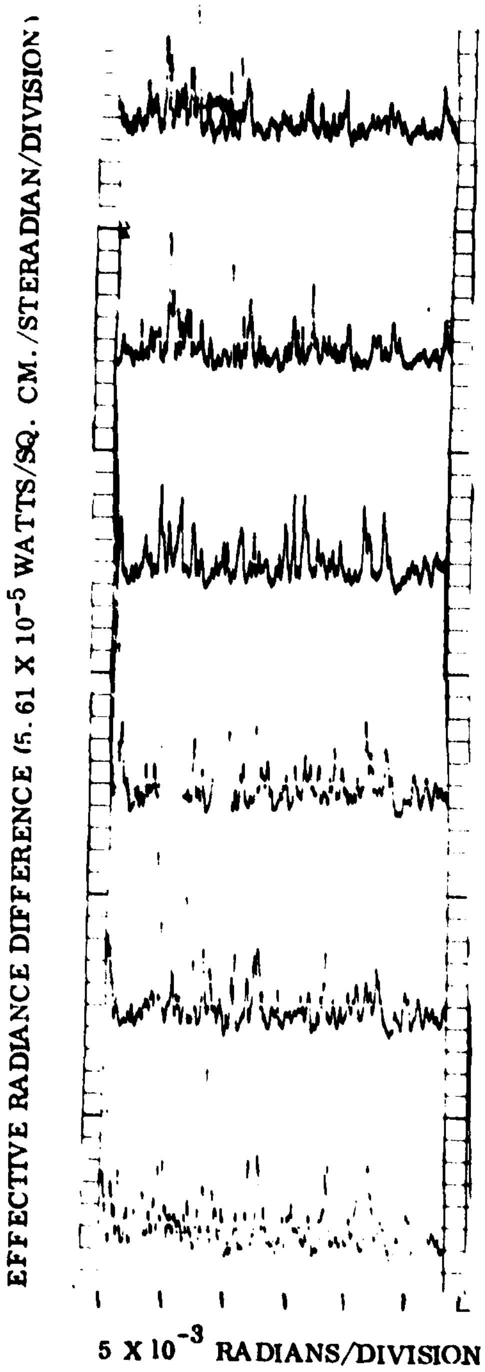
3.2-4.77 μm
EFFECTIVE RADIANCE DIFFERENCE (5.19 X 10⁻⁵ WATTS/SQ. CM./STERADIAN/DIVISION)
5 x 10⁻³ RADIANS DIVISION



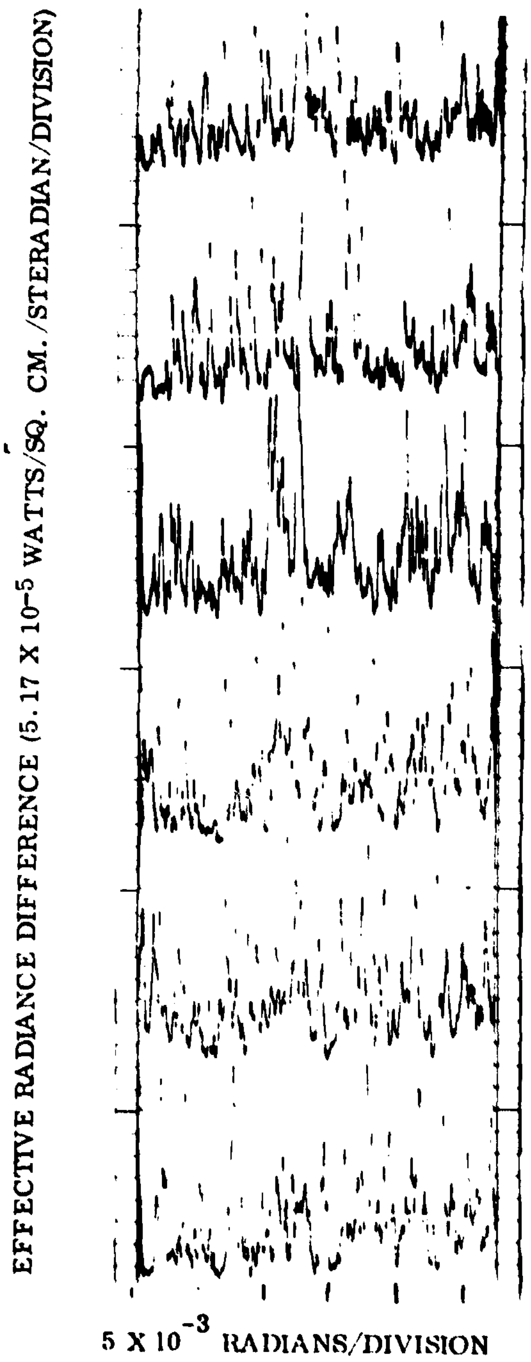
4.4-4.77 μm
EFFECTIVE RADIANCE DIFFERENCE (3.37 X 10⁻⁵ WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10⁻³ RADIANS DIVISION

TARGET 5

3.8-4.2μm



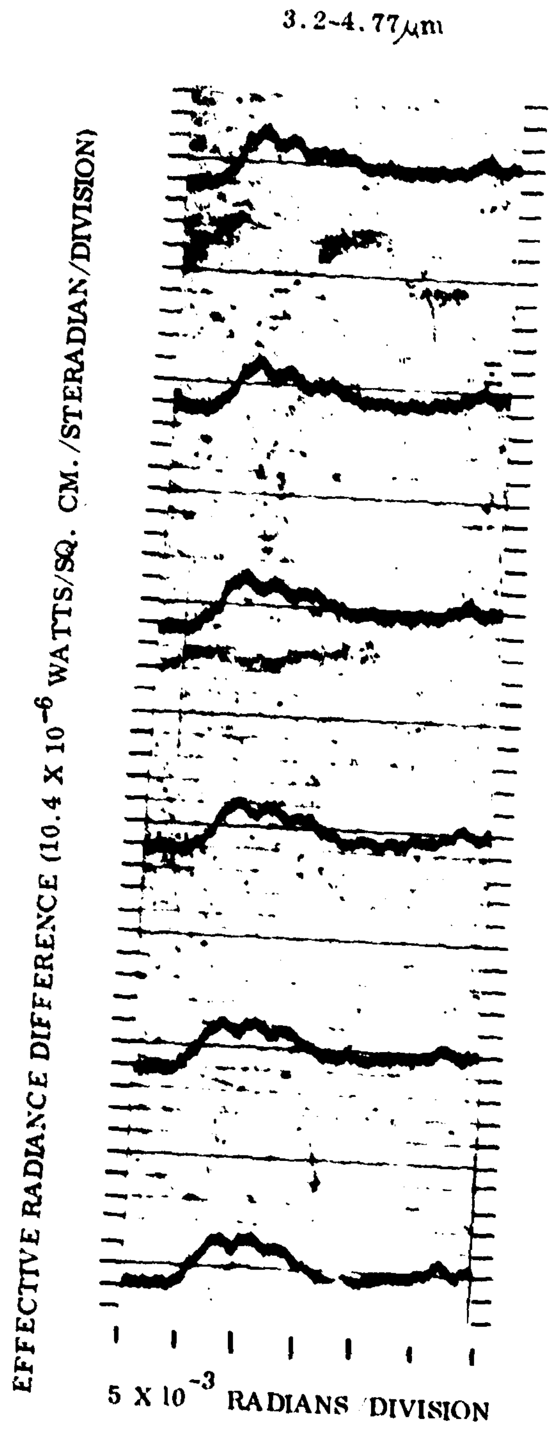
3.4-4.3μm



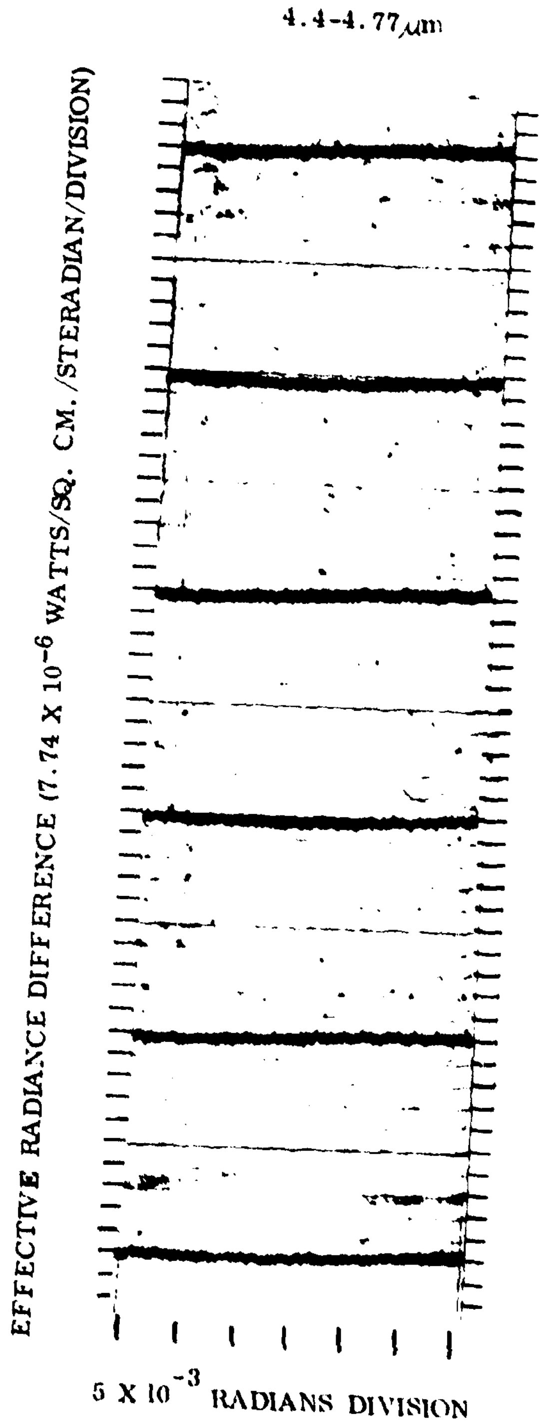
TARGET 7

DATE: 2 MAY 1979
TIME: 10:15
TEMPERATURE: 81^{o}F
RELATIVE HUMIDITY: 65%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 60^{o}
TARGET ELEVATION: 4.9^{o}
SUN TO TARGET ASPECT ANGLE: 58^{o}

TARGET 7

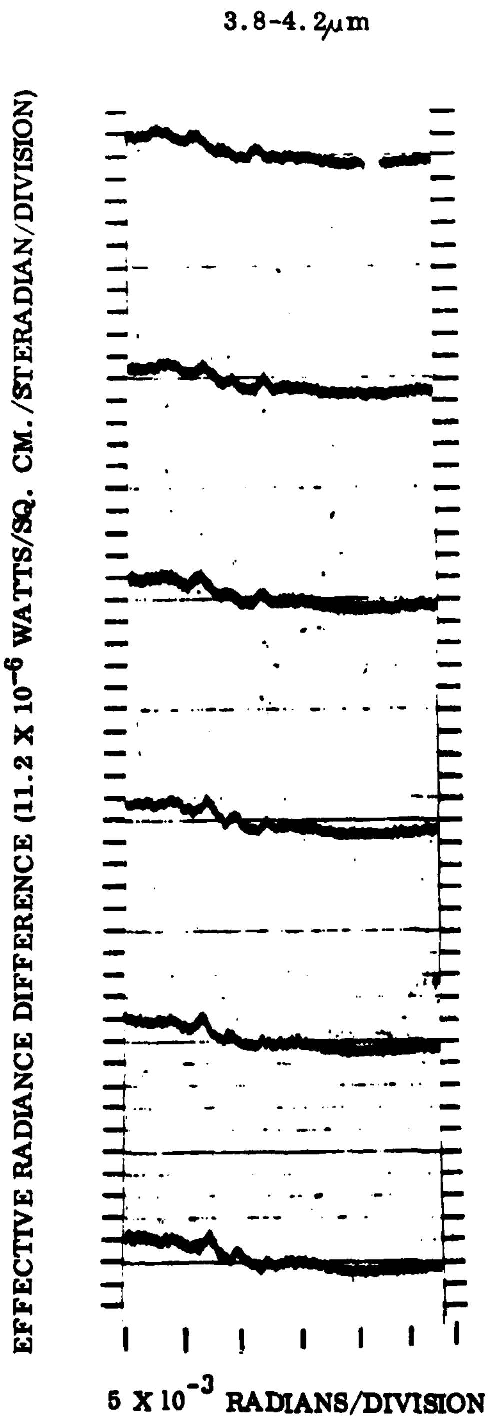


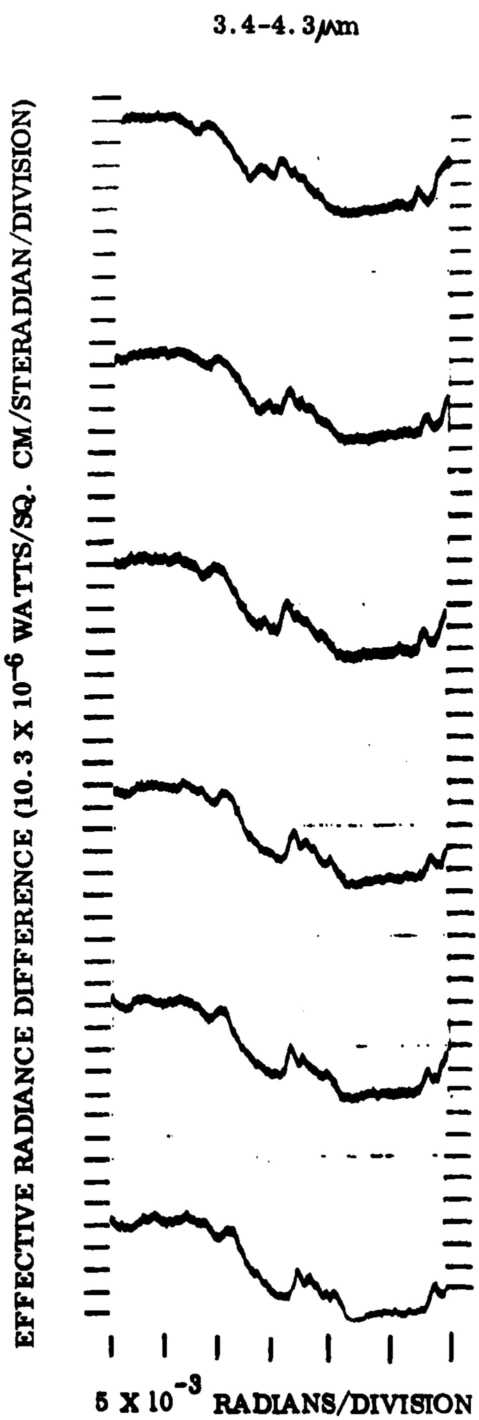
3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION



4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION

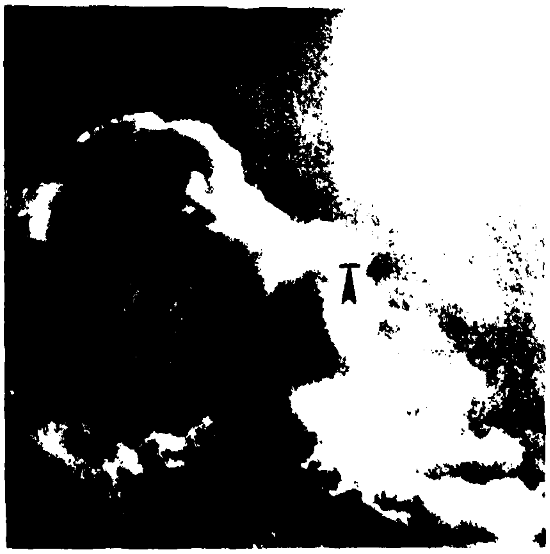
TARGET 7


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

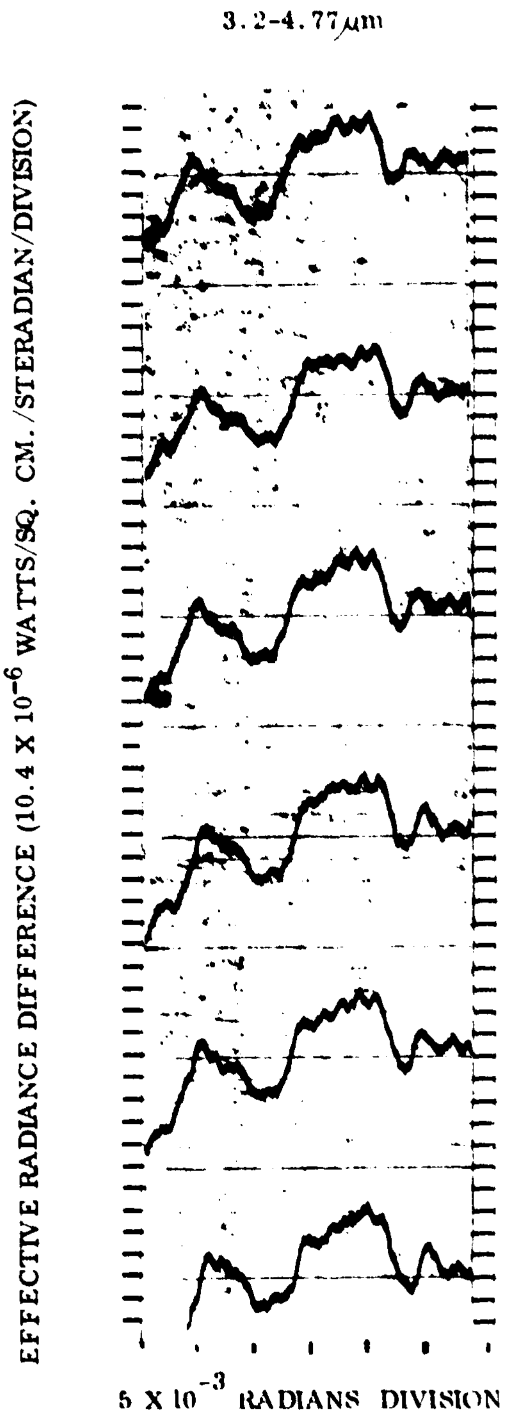

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

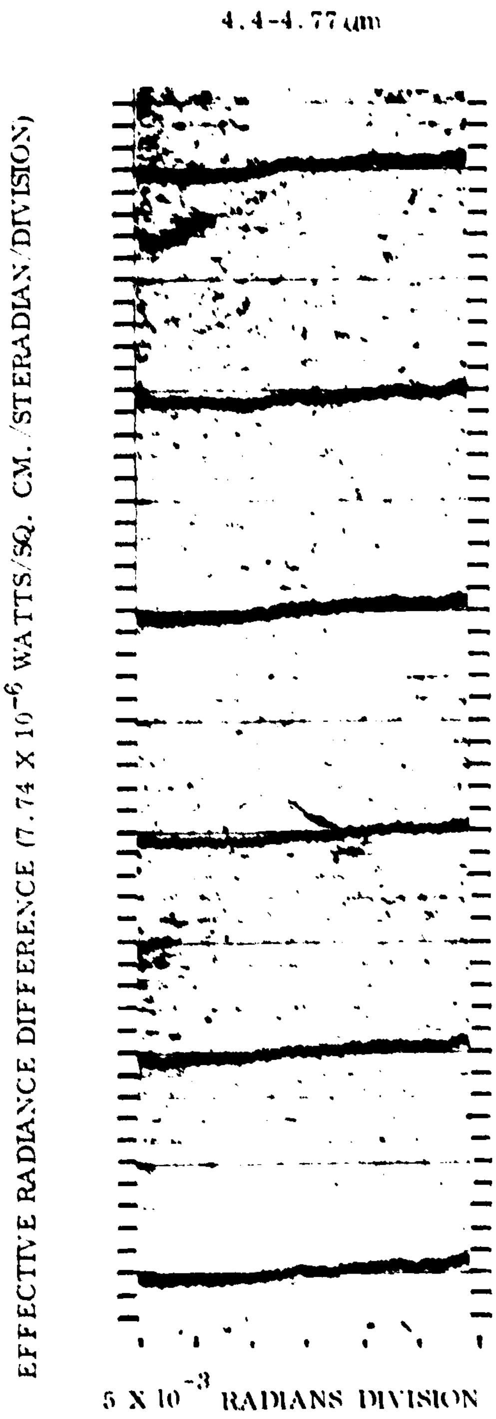
TARGET 8

DATE: 2 MAY 1979
TIME: 10:25
TEMPERATURE: 81°F
RELATIVE HUMIDITY: 62%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 90°
TARGET ELEVATION: 10.3°
SUN TO TARGET ASPECT ANGLE: 47°
CORRELATED WITH IRST CLUTTER

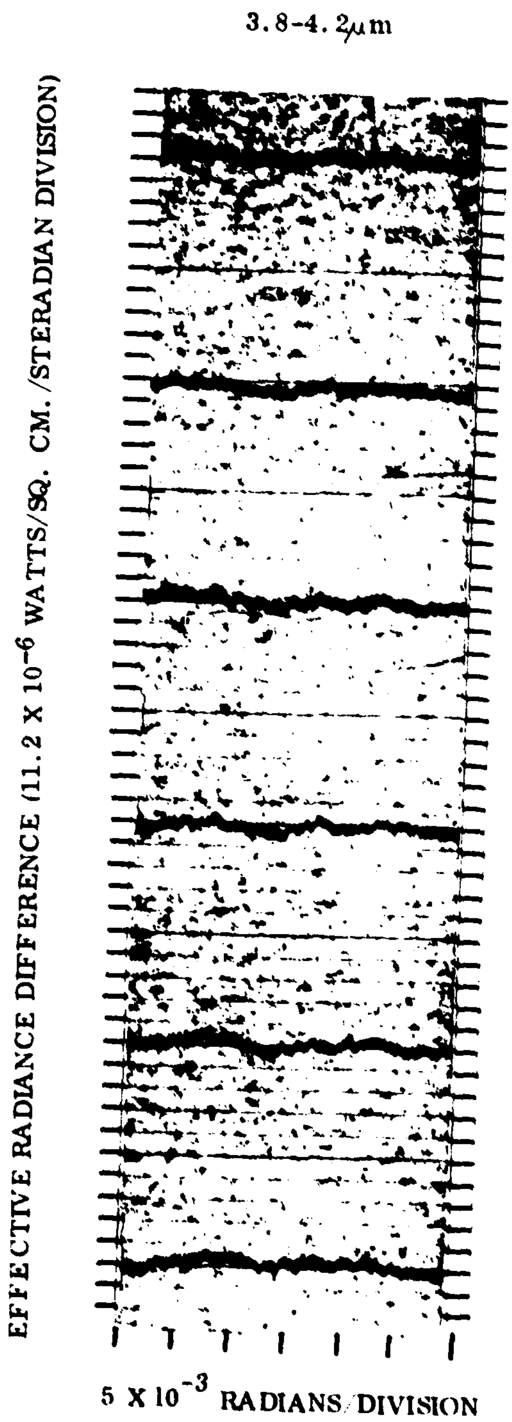


TARGET 8

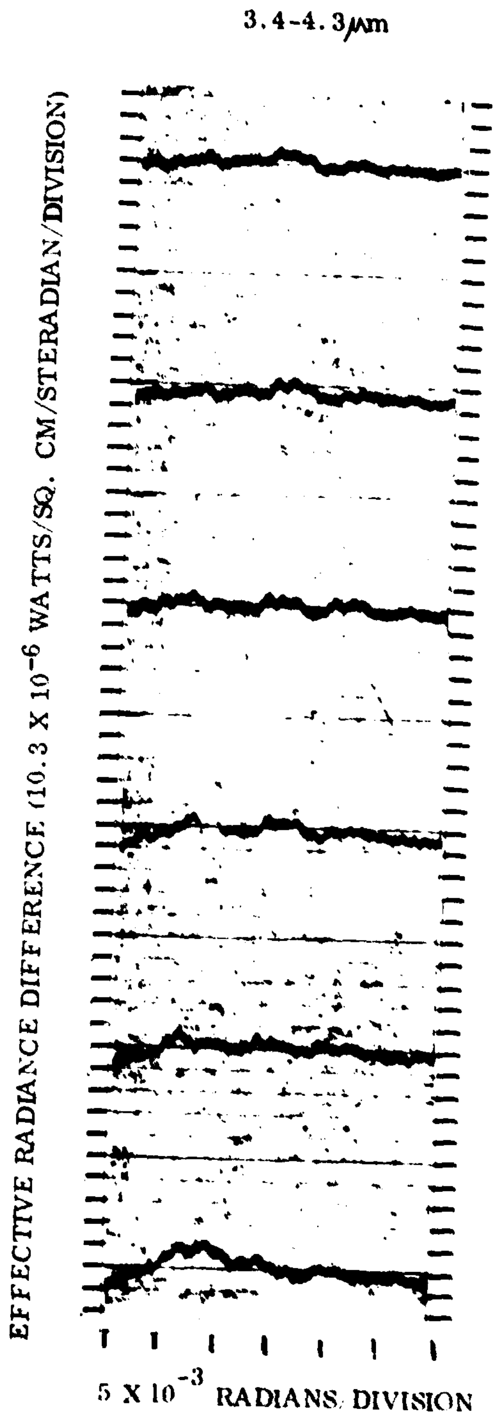

3.2-4.77 µm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^{-6} WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^{-3} RADIANS DIVISION


4.4-4.77 µm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^{-6} WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^{-3} RADIANS DIVISION

TARGET 8



3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

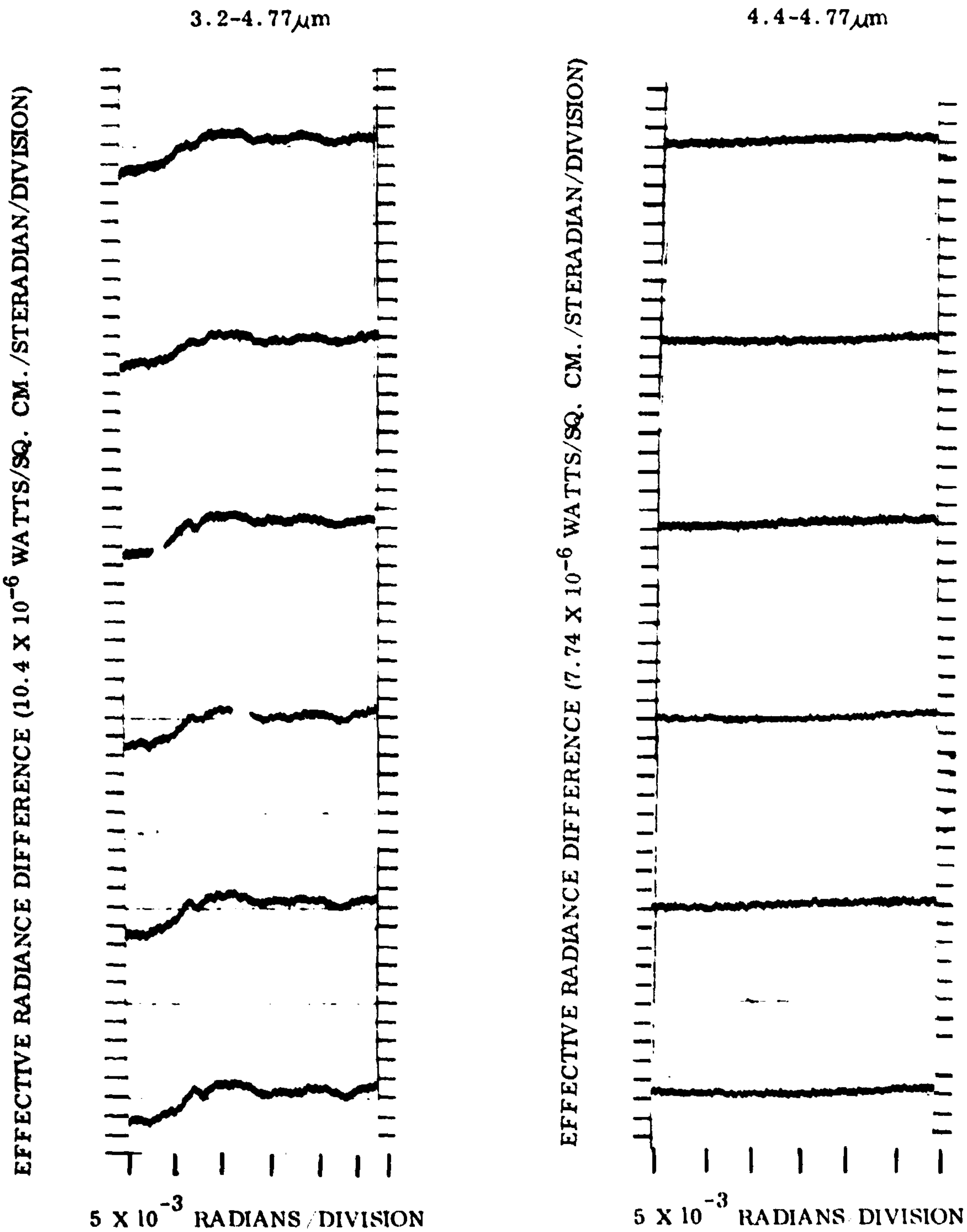


3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 9

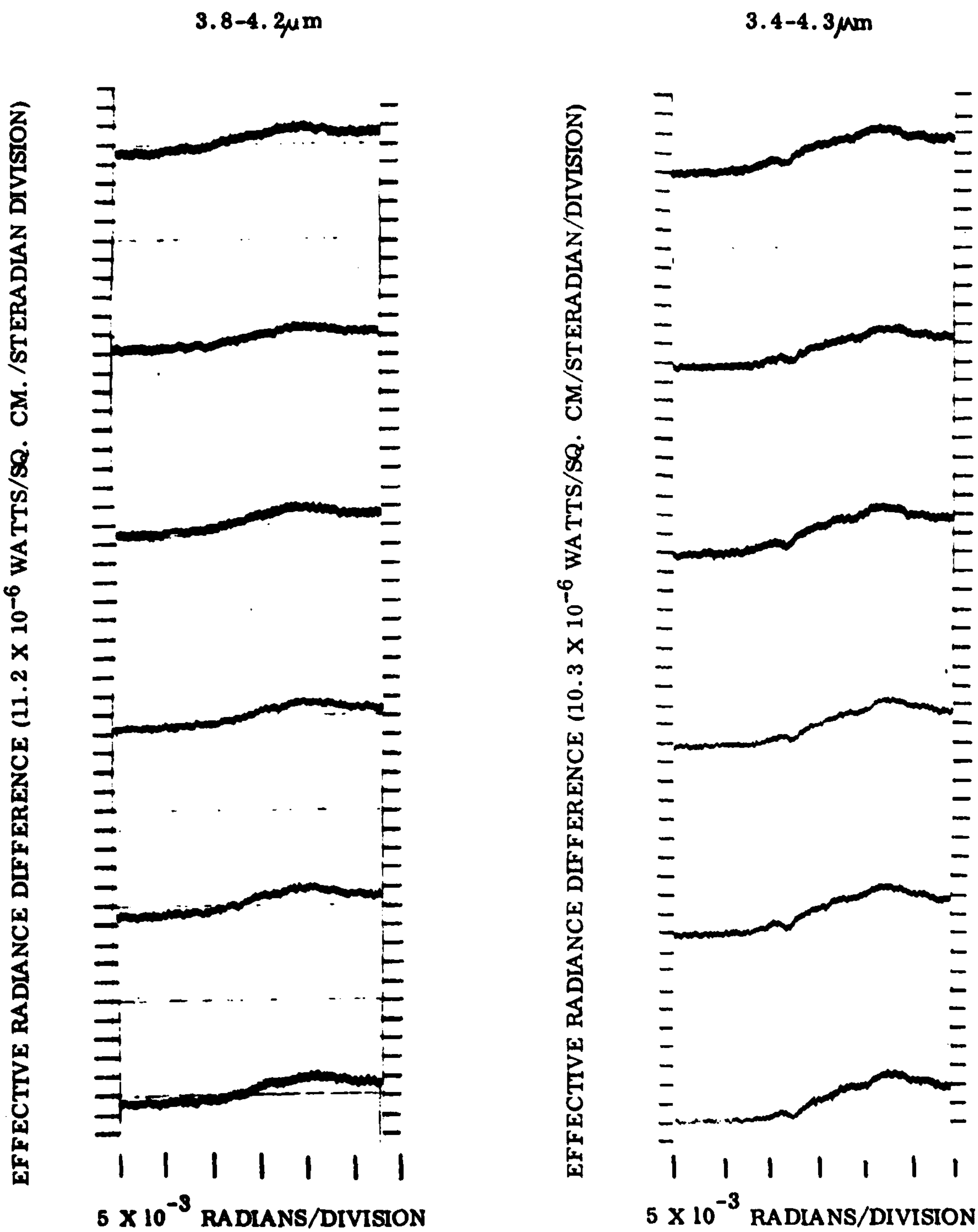
DATE: 2 MAY 1979
TIME: 10:32
TEMPERATURE: 81^{O}F
RELATIVE HUMIDITY: 62%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 40^{O}
TARGET ELEVATION: 2.0^{O}
SUN TO TARGET ASPECT ANGLE: 72^{O}
CORRELATED WITH IRST CLUTTER

TARGET 9



3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION
4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

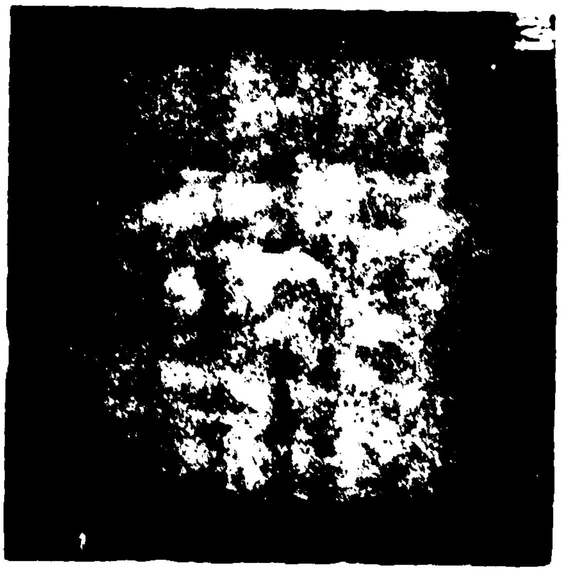
TARGET 9



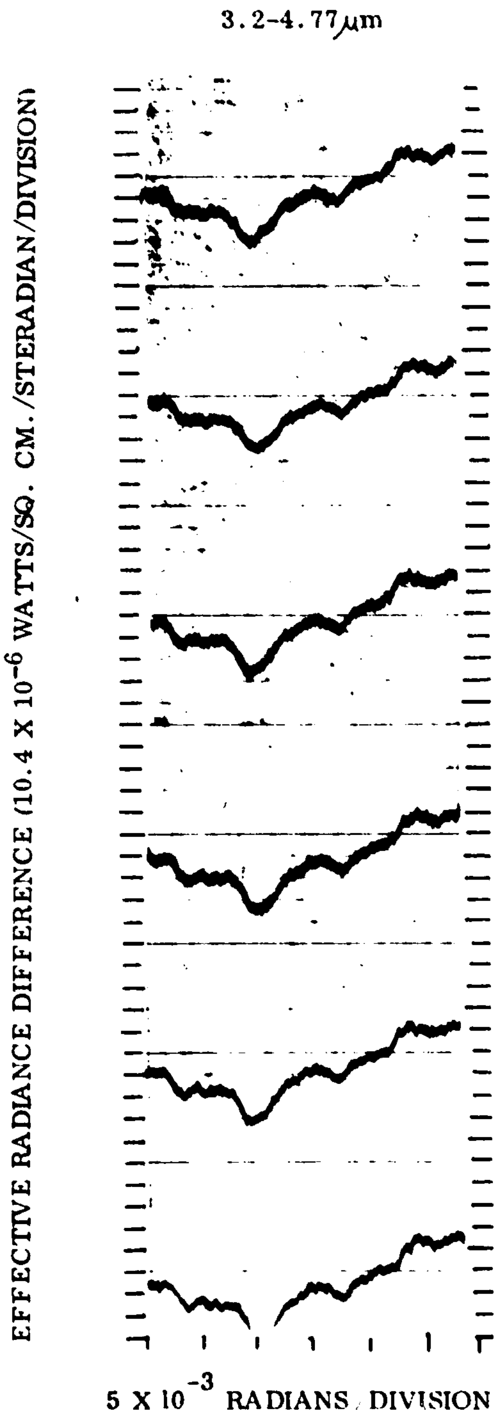
3.8-4.2μm
3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM. /STERADIAN DIVISION)
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION
5 X 10^-3 RADIANS/DIVISION

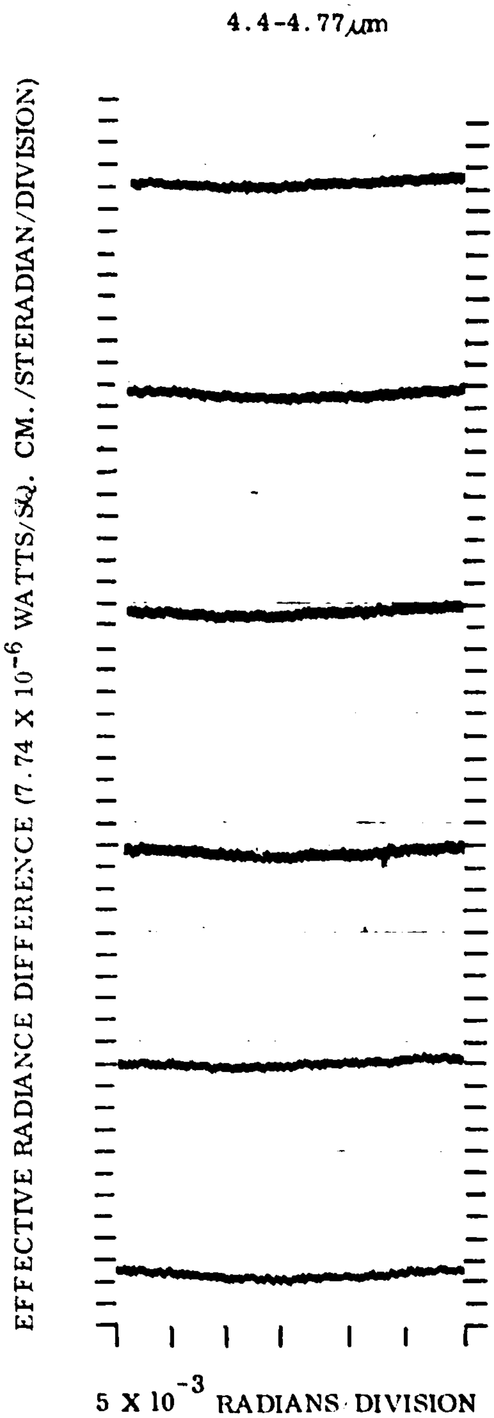
TARGET 11

DATE: 3 MAY 1979
TIME: 10:15
TEMPERATURE: 81°F
RELATIVE HUMIDITY: 65%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 120°
TARGET ELEVATION: 7.2°
SUN TO TARGET ASPECT ANGLE: 52°

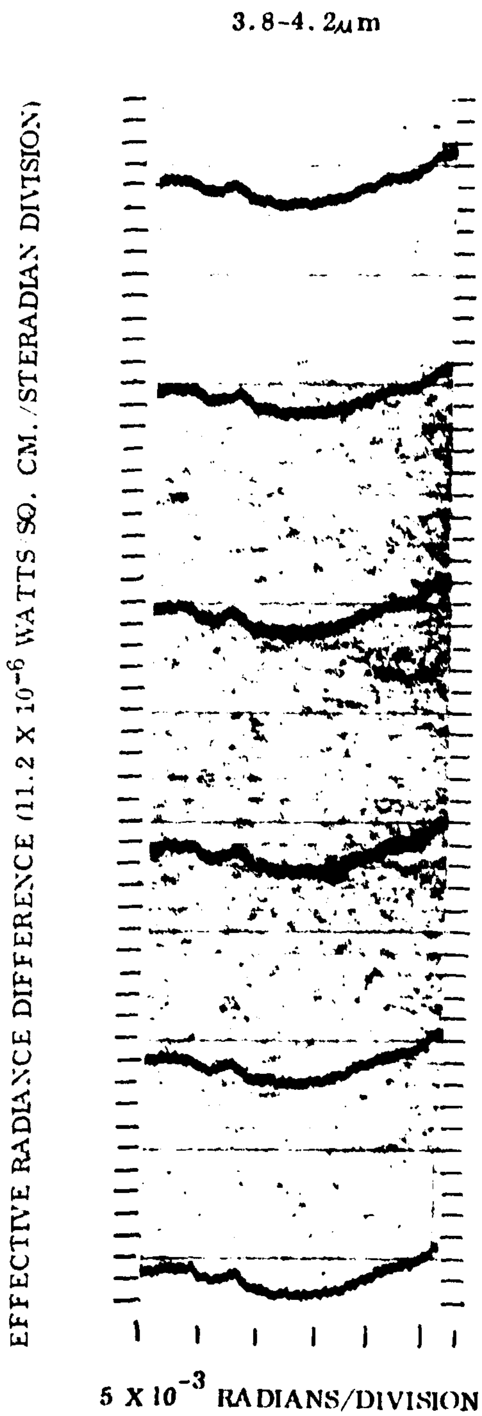


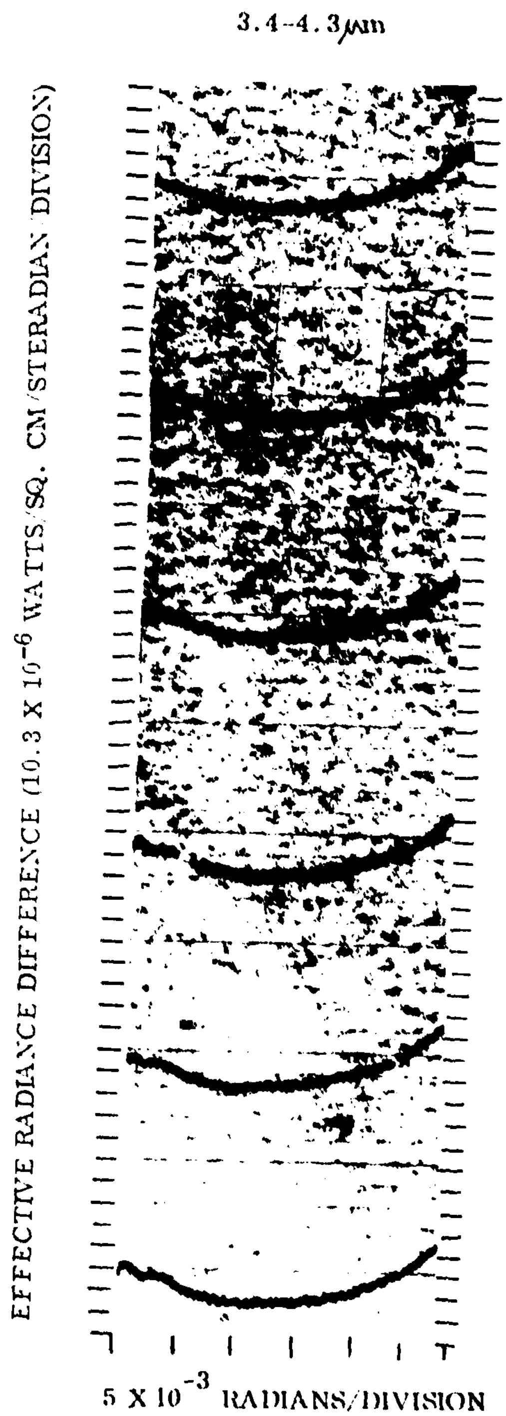
TARGET 11


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION


4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 11

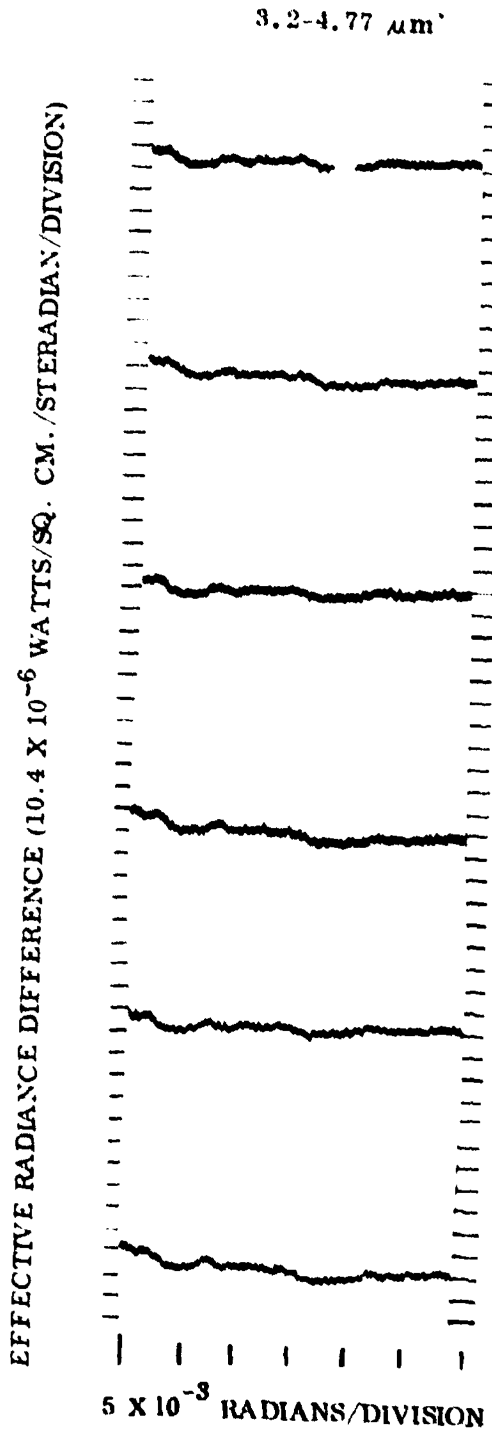

3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION


3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS SQ. CM/STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 14

DATE: 3 MAY 1979
TIME: 13:40
TEMPERATURE: 82^{o}F
RELATIVE HUMIDITY: 62%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: NOT AVAILABLE
TARGET ELEVATION: NOT AVAILABLE
SUN TO TARGET ASPECT ANGLE: NOT AVAILABLE

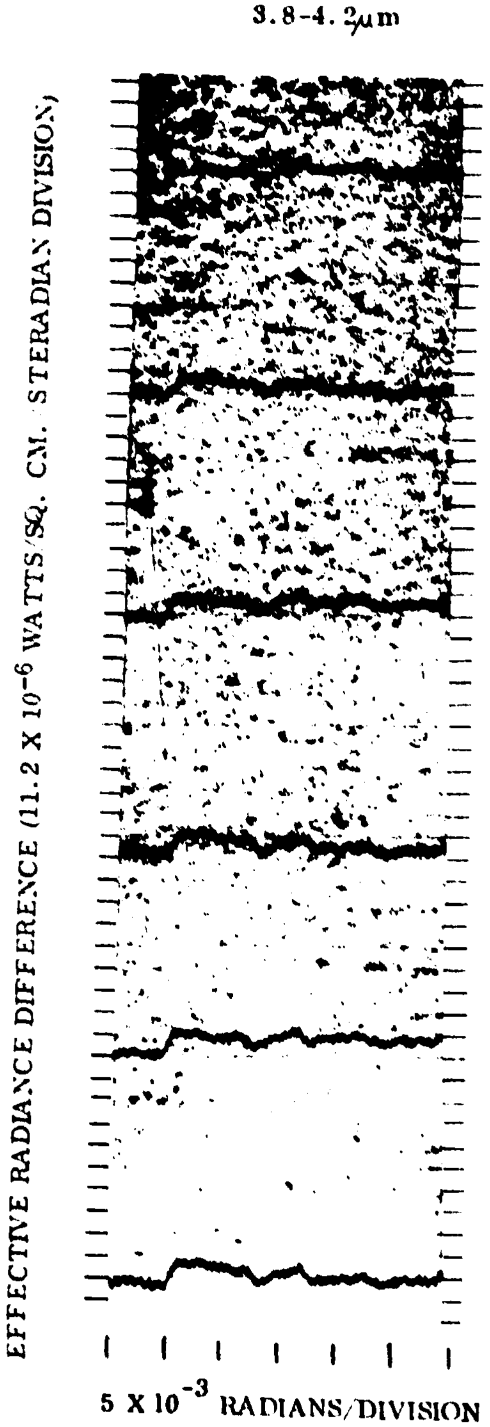
TARGET 14



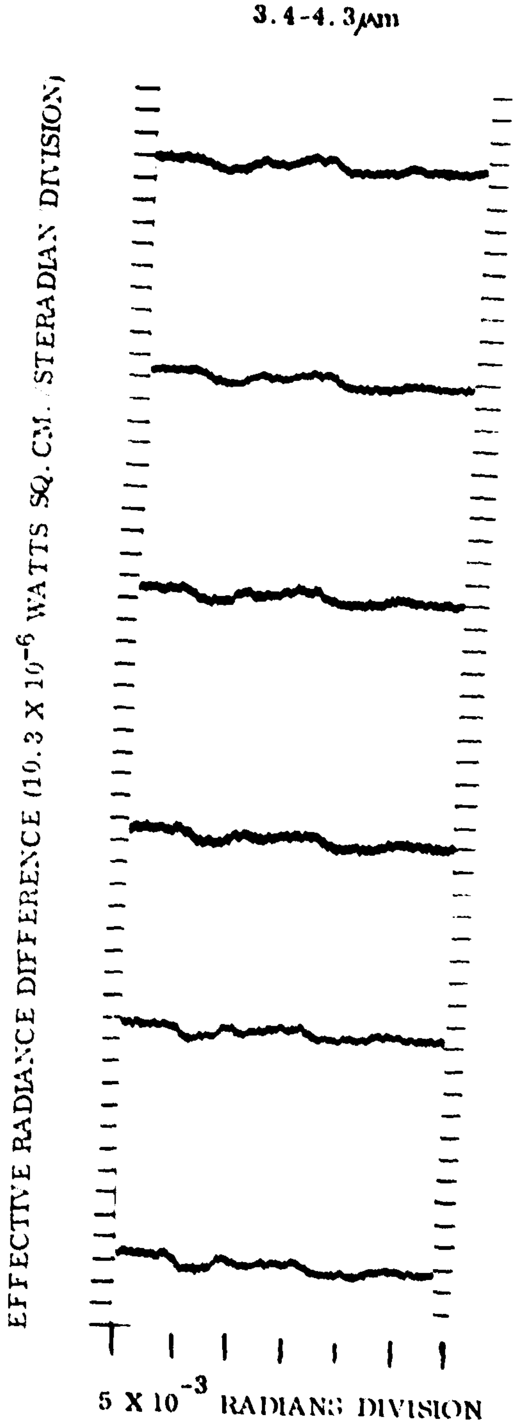
3.2-4.77 µm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^{-6} WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^{-3} RADIANS/DIVISION

4.4-4.77 µm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^{-6} WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^{-3} RADIANS/DIVISION

TARGET 14



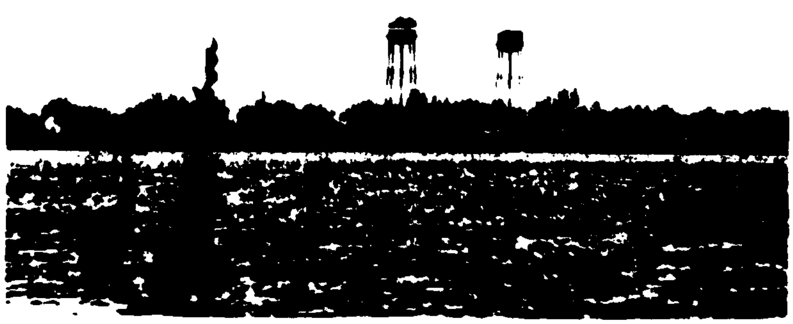
3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM. STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION



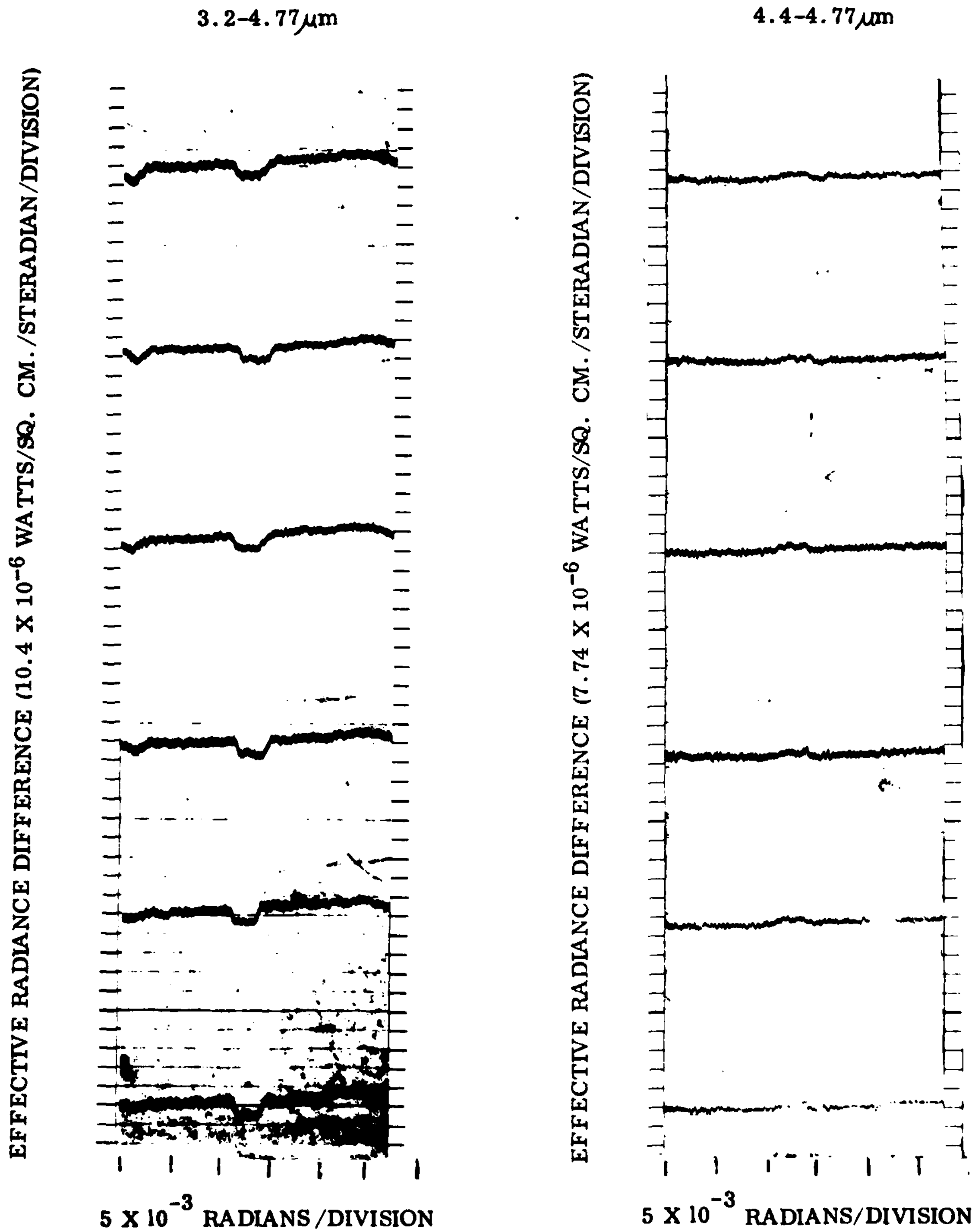
3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS SQ.CM. STERADIAN DIVISION)
5 X 10^-3 RADIANS DIVISION

TARGET 19

DATE: 4 MAY 1979
TIME: 9:44
TEMPERATURE: 83 °F
RELATIVE HUMIDITY: 59%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 123°
TARGET ELEVATION: 1.0°
SUN TO TARGET ASPECT ANGLE: 55°
WATER TOWER

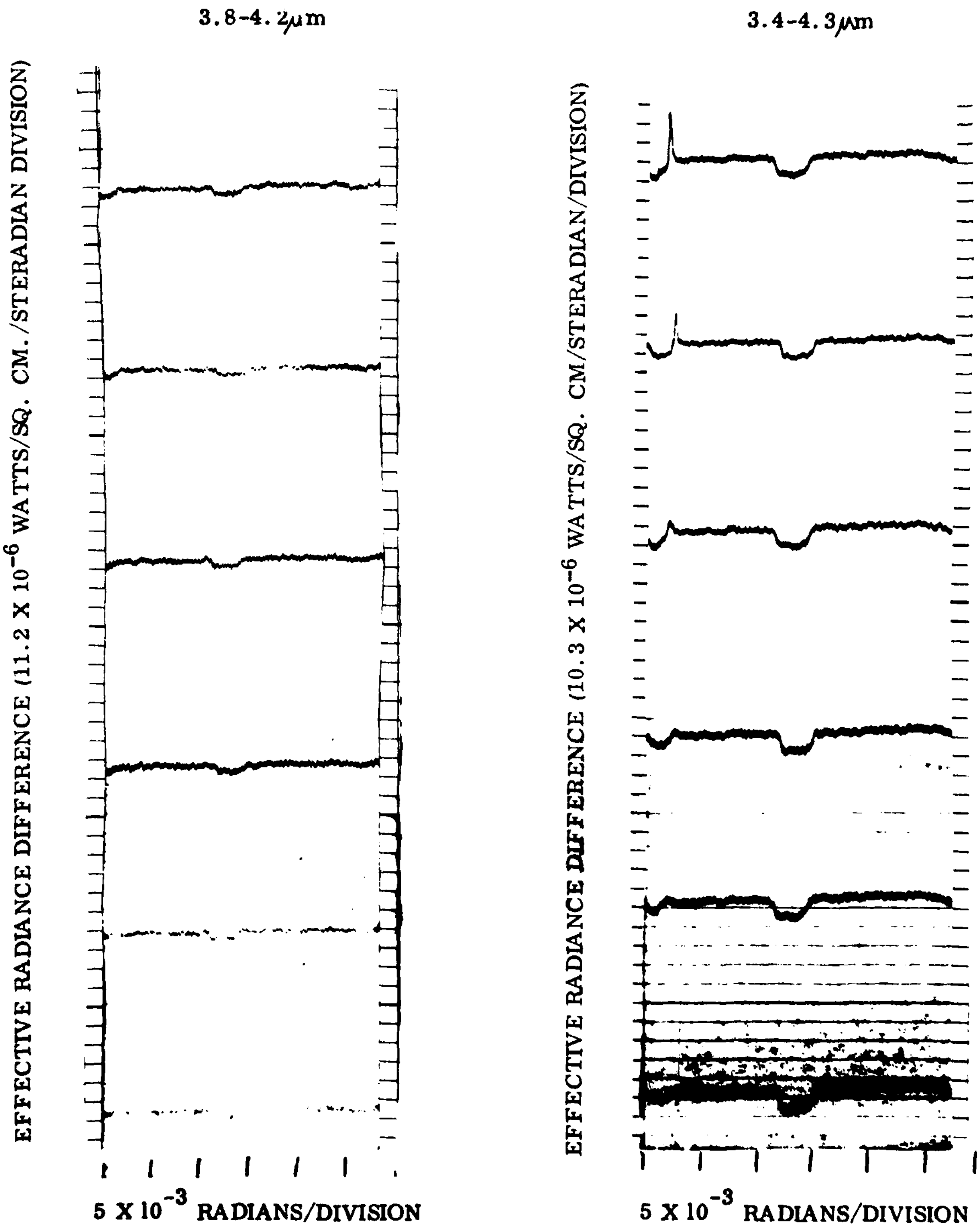


TARGET 19

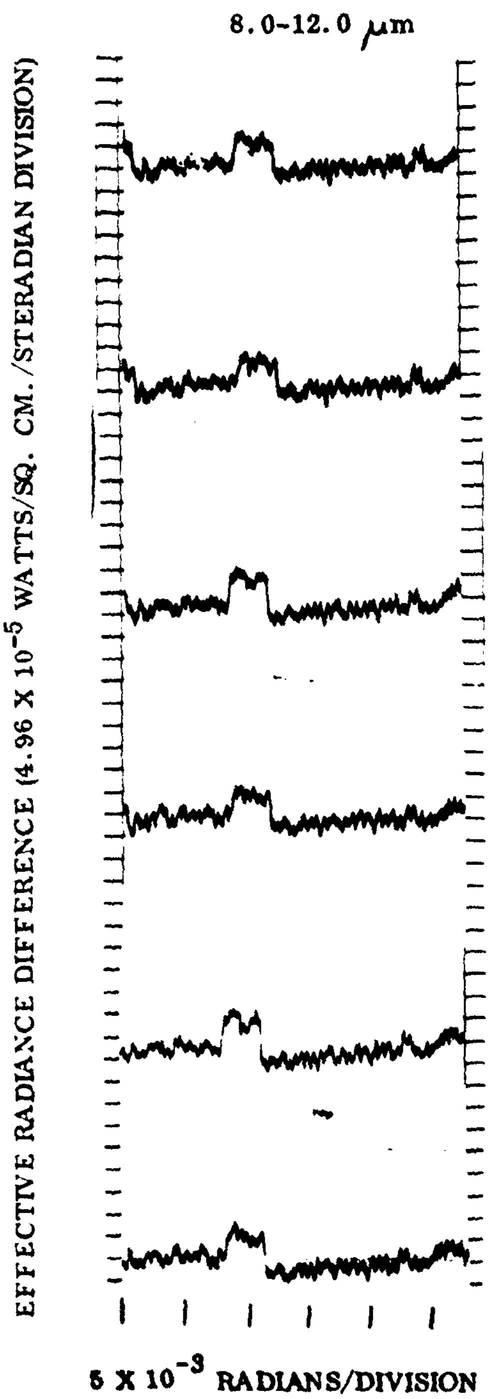


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION
4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

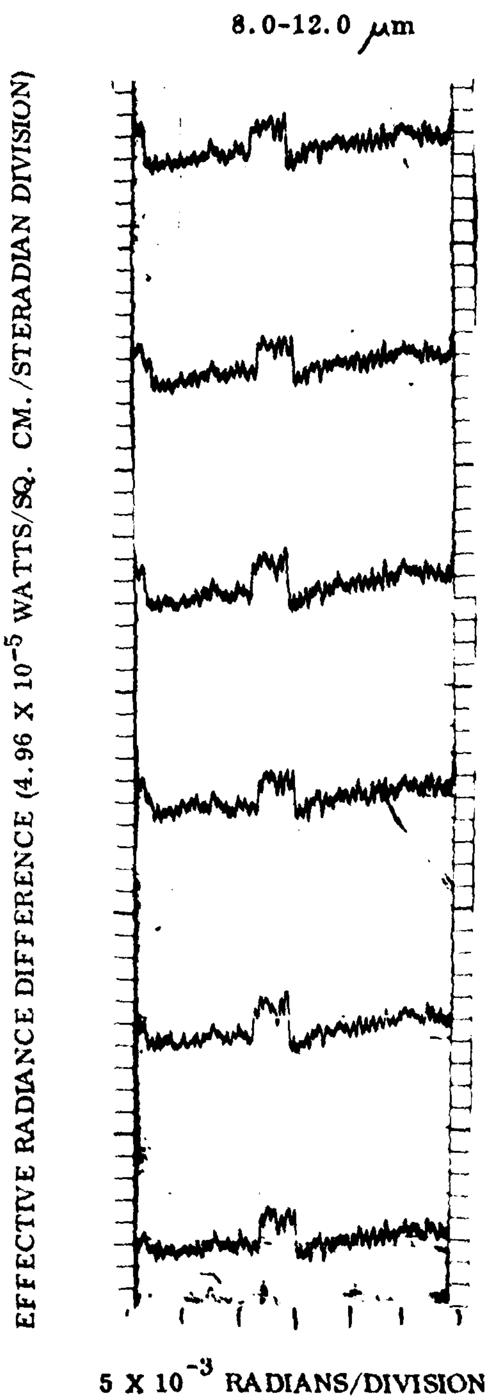
TARGET 19


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION
3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 19



8.0-12.0 μm
EFFECTIVE RADIANCE DIFFERENCE (4.96 X 10^-5 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

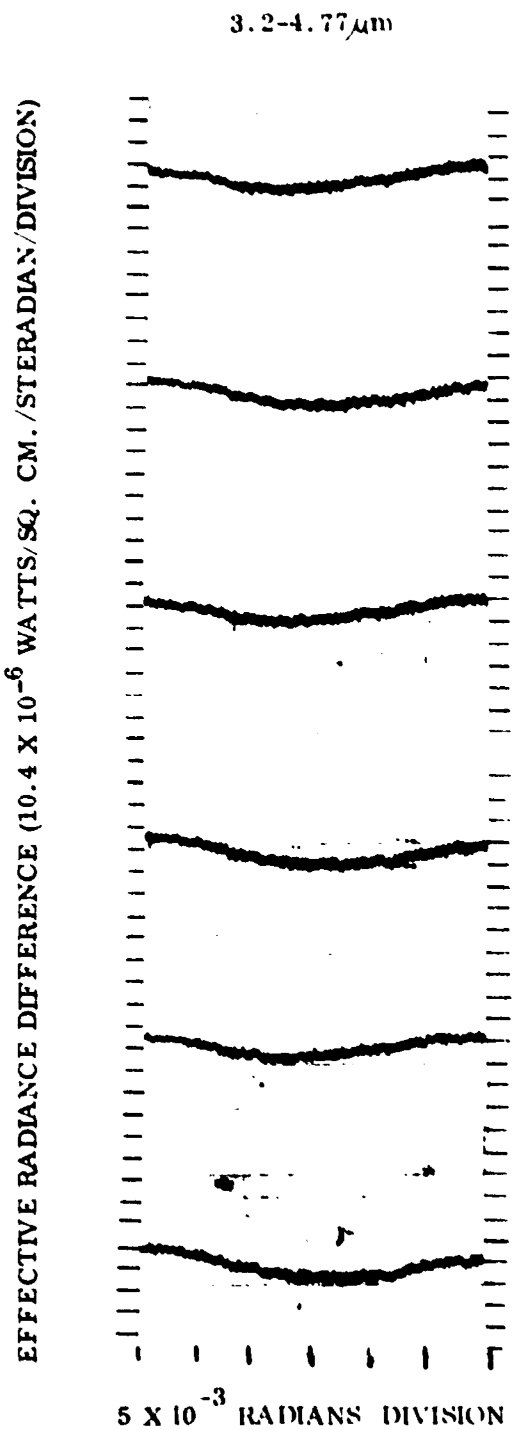


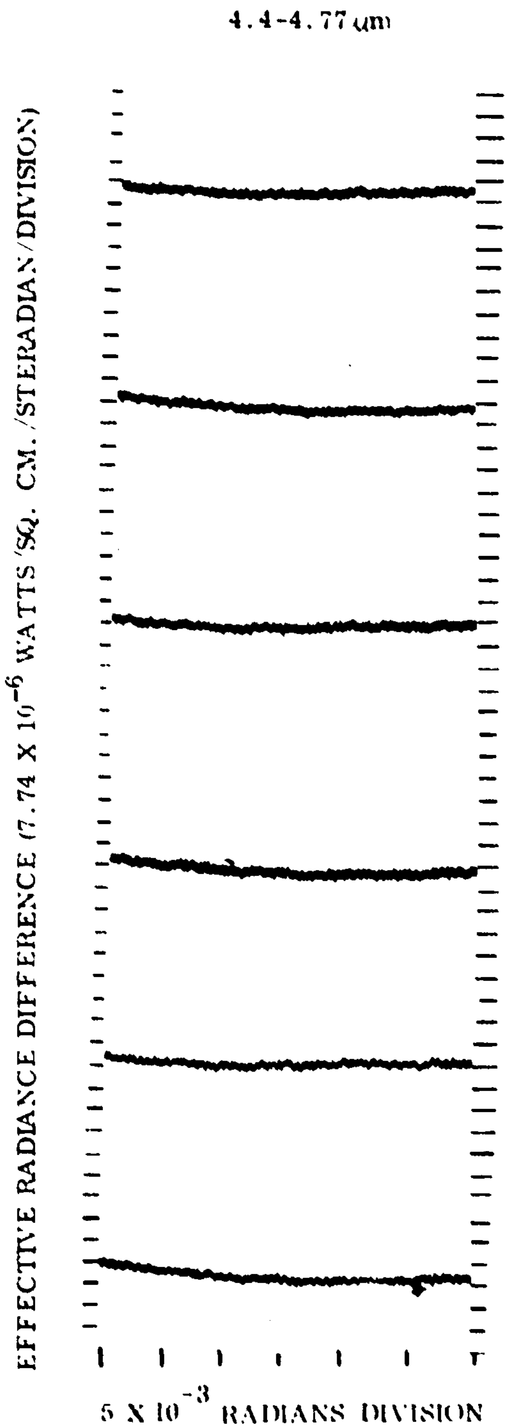
8.0-12.0 μm
EFFECTIVE RADIANCE DIFFERENCE (4.96 X 10^-5 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 21

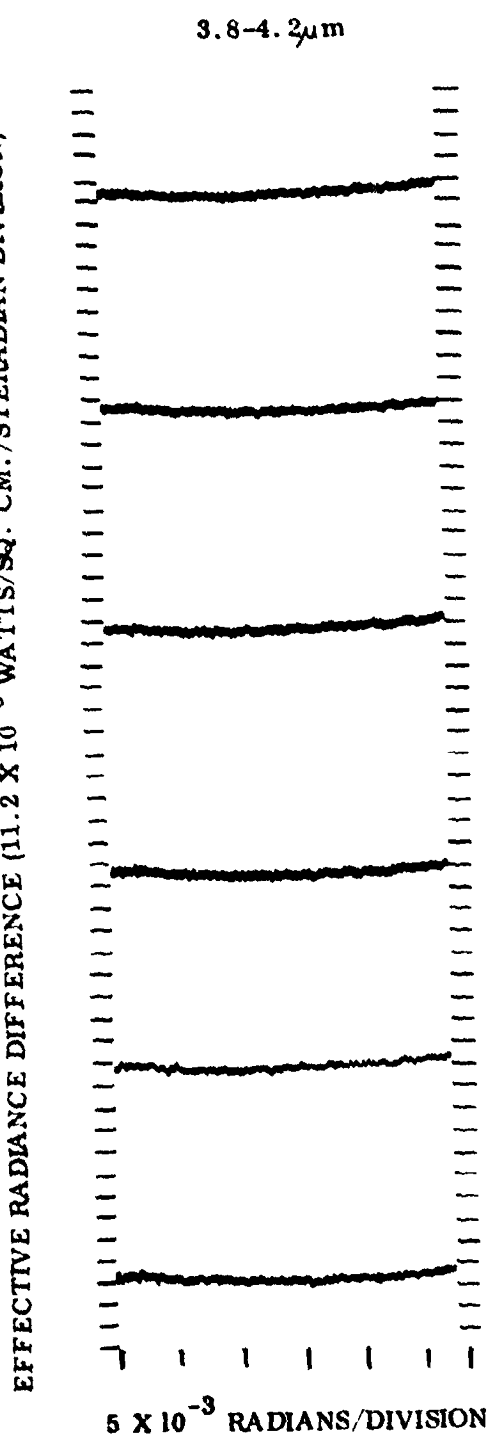
DATE: 4 MAY 1979
TIME: 14:04
TEMPERATURE: 84°F
RELATIVE HUMIDITY: 53%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: NOT AVAILABLE
TARGET ELEVATION: NOT AVAILABLE
SUN TO TARGET ASPECT ANGLE: NOT AVAILABLE

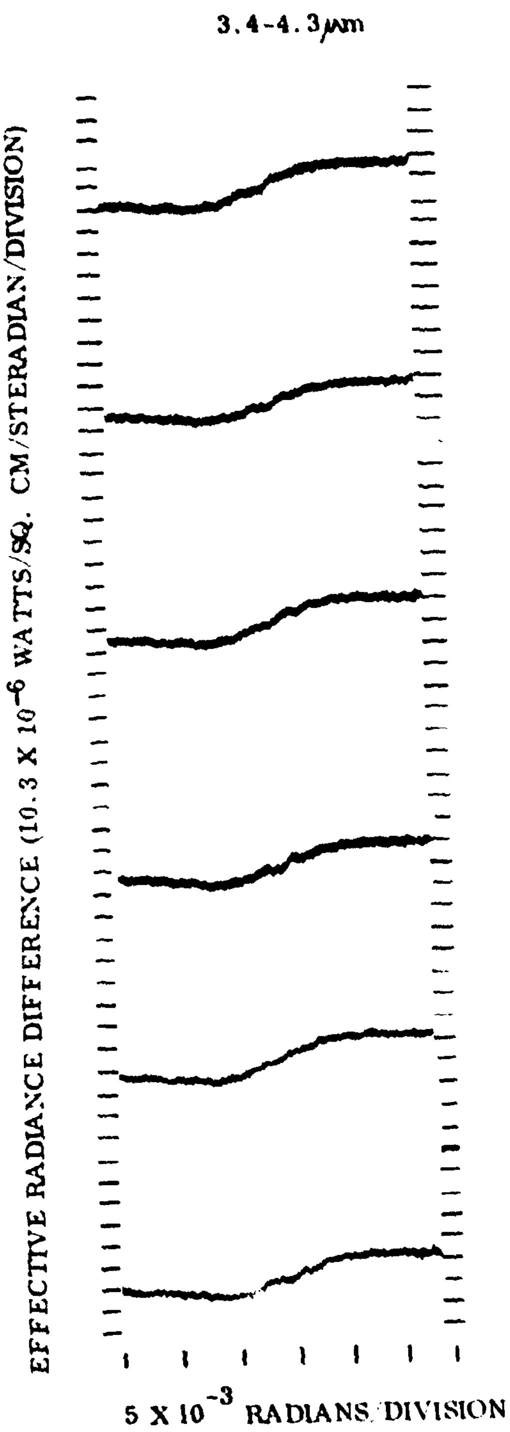
TARGET 21


3.2-4.77 μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION


4.4-4.77 μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION

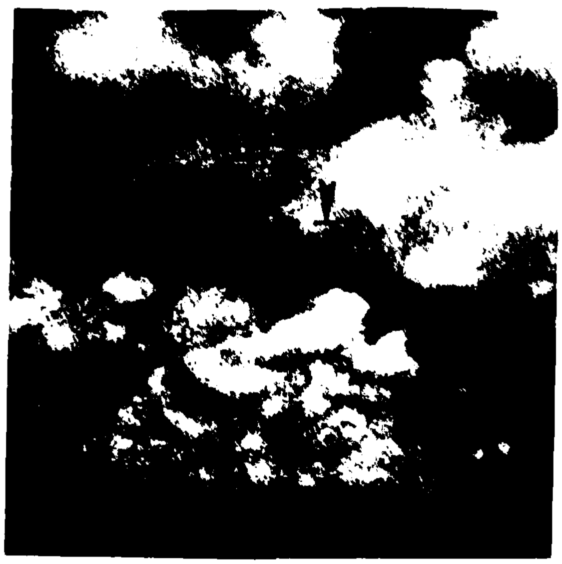
TARGET 21


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

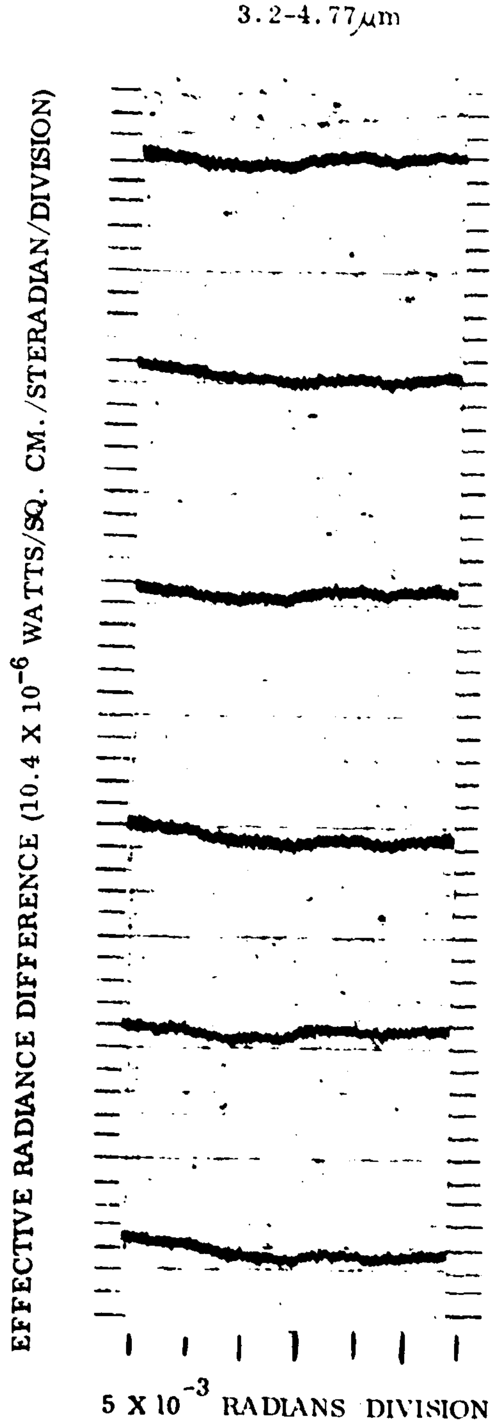

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

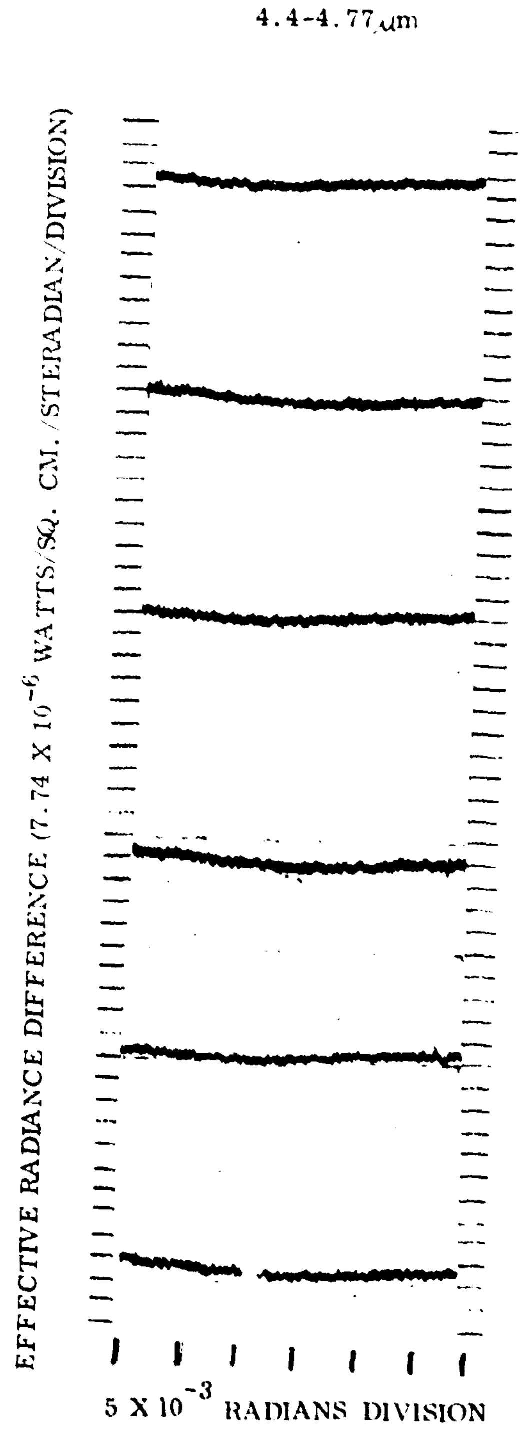
TARGET 22

DATE: 4 MAY 1979
TIME: 14:30
TEMPERATURE: 83°F
RELATIVE HUMIDITY: 58%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 93°
TARGET ELEVATION: 5.0°
SUN TO TARGET ASPECT ANGLE: 104°

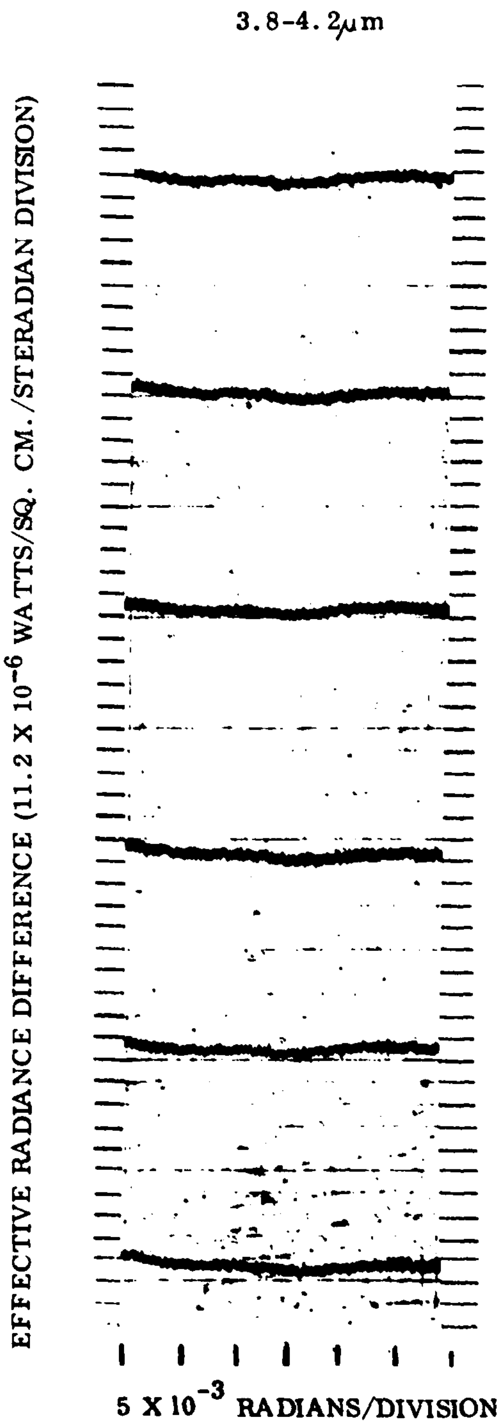


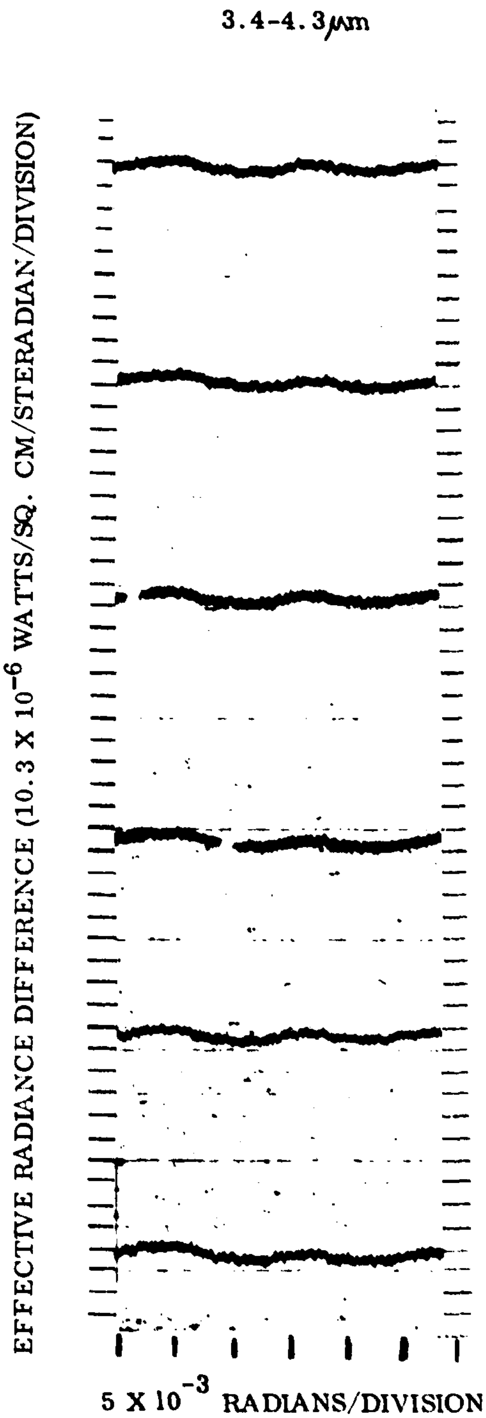
TARGET 22


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION


4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION

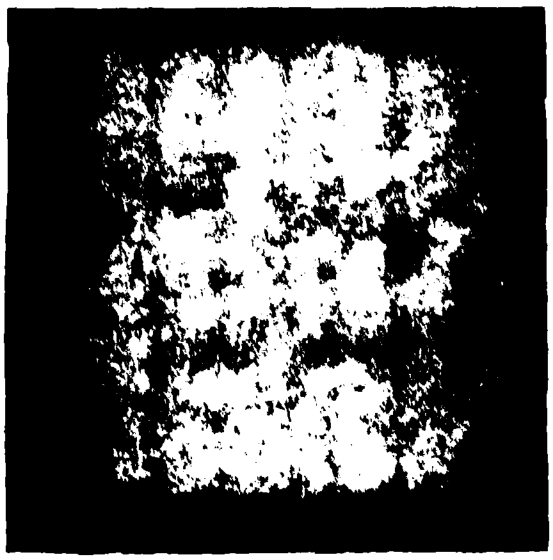
TARGET 22


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION


3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

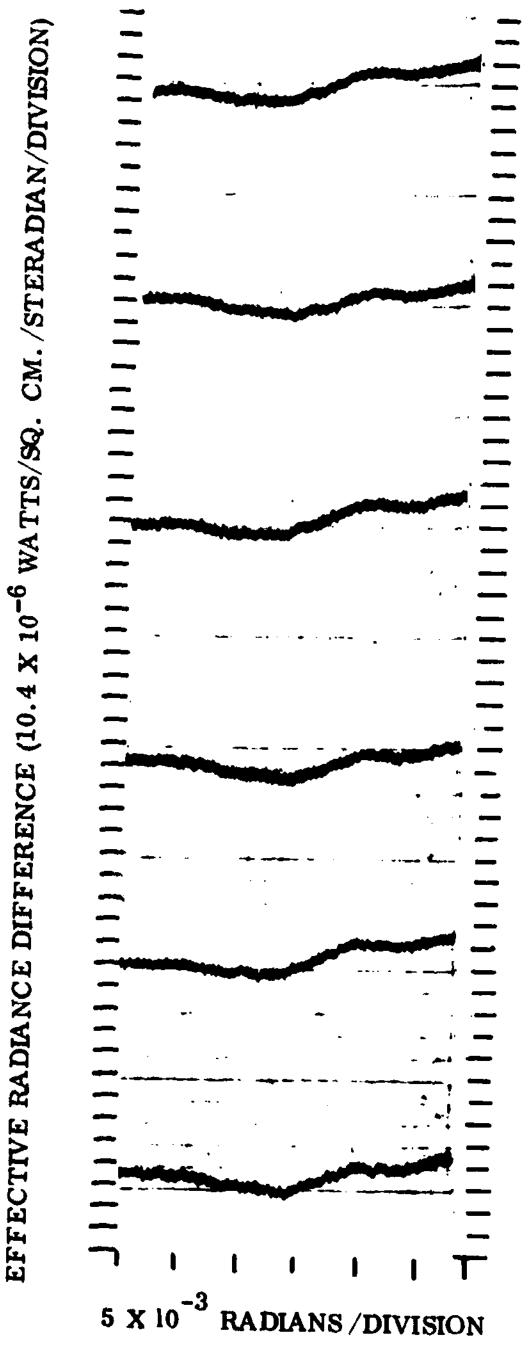
TARGET 24

DATE: 4 MAY 1979
TIME: 14:48
TEMPERATURE: 84^{o}F
RELATIVE HUMIDITY: 58%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 62^{o}
TARGET ELEVATION: 10.4^{o}
SUN TO TARGET ASPECT ANGLE: 102^{o}

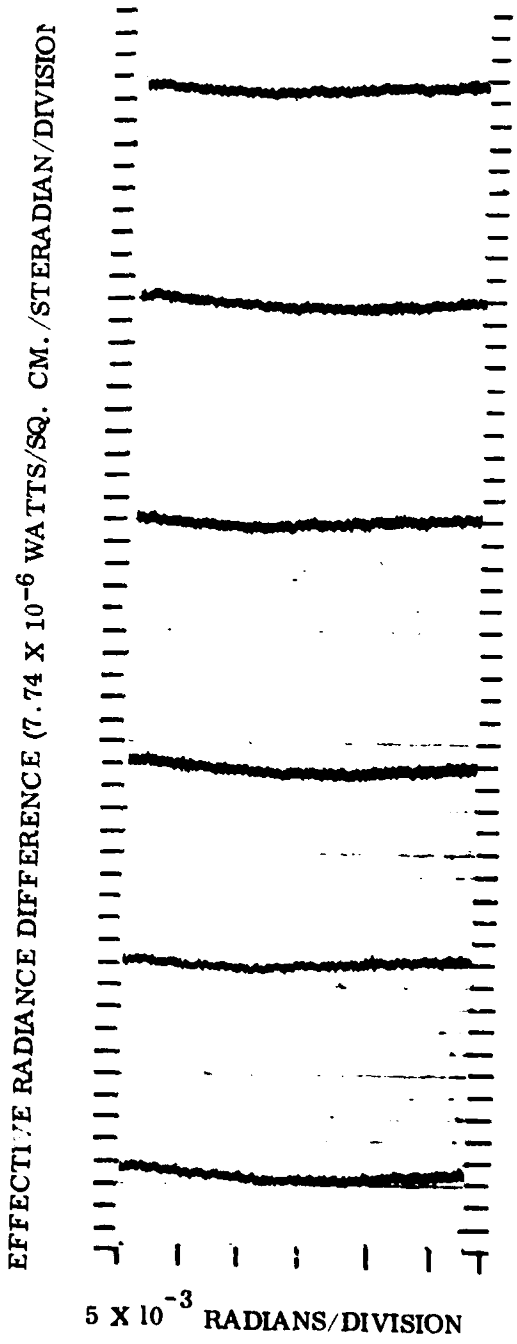


TARGET 24

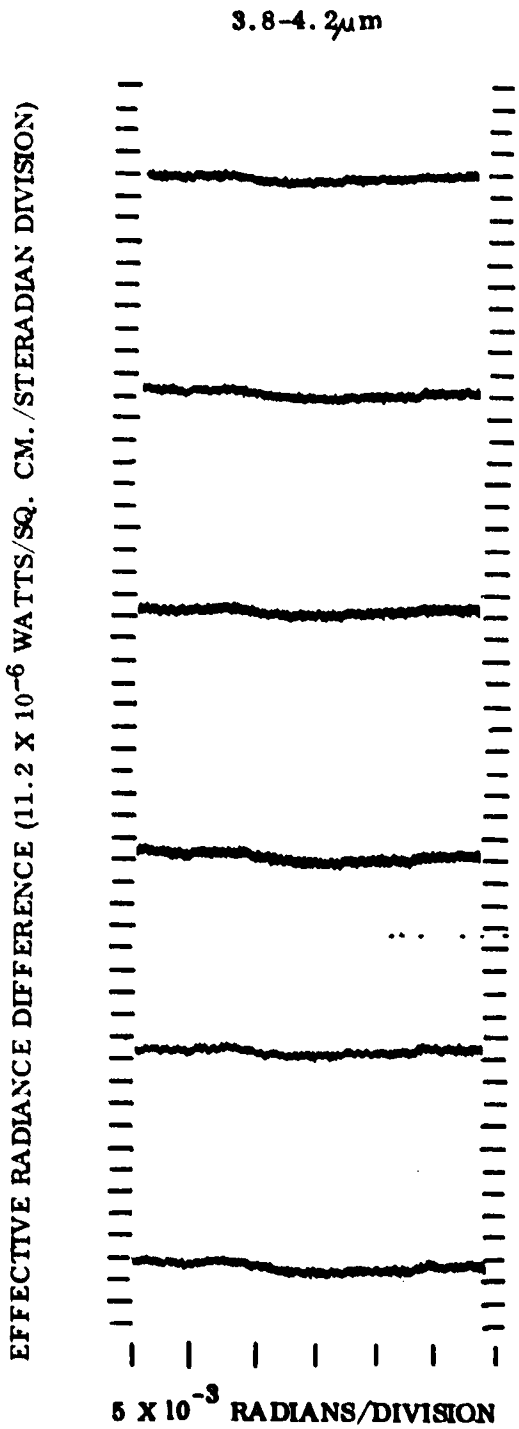
3.2-4.77μm

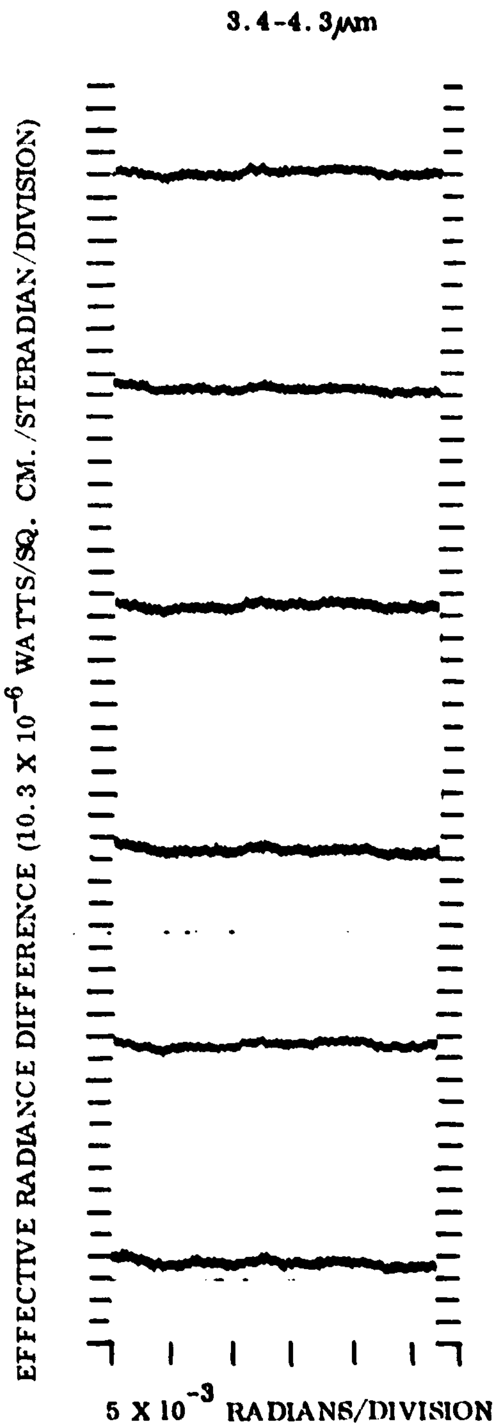


4.4-4.77μm



TARGET 24


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

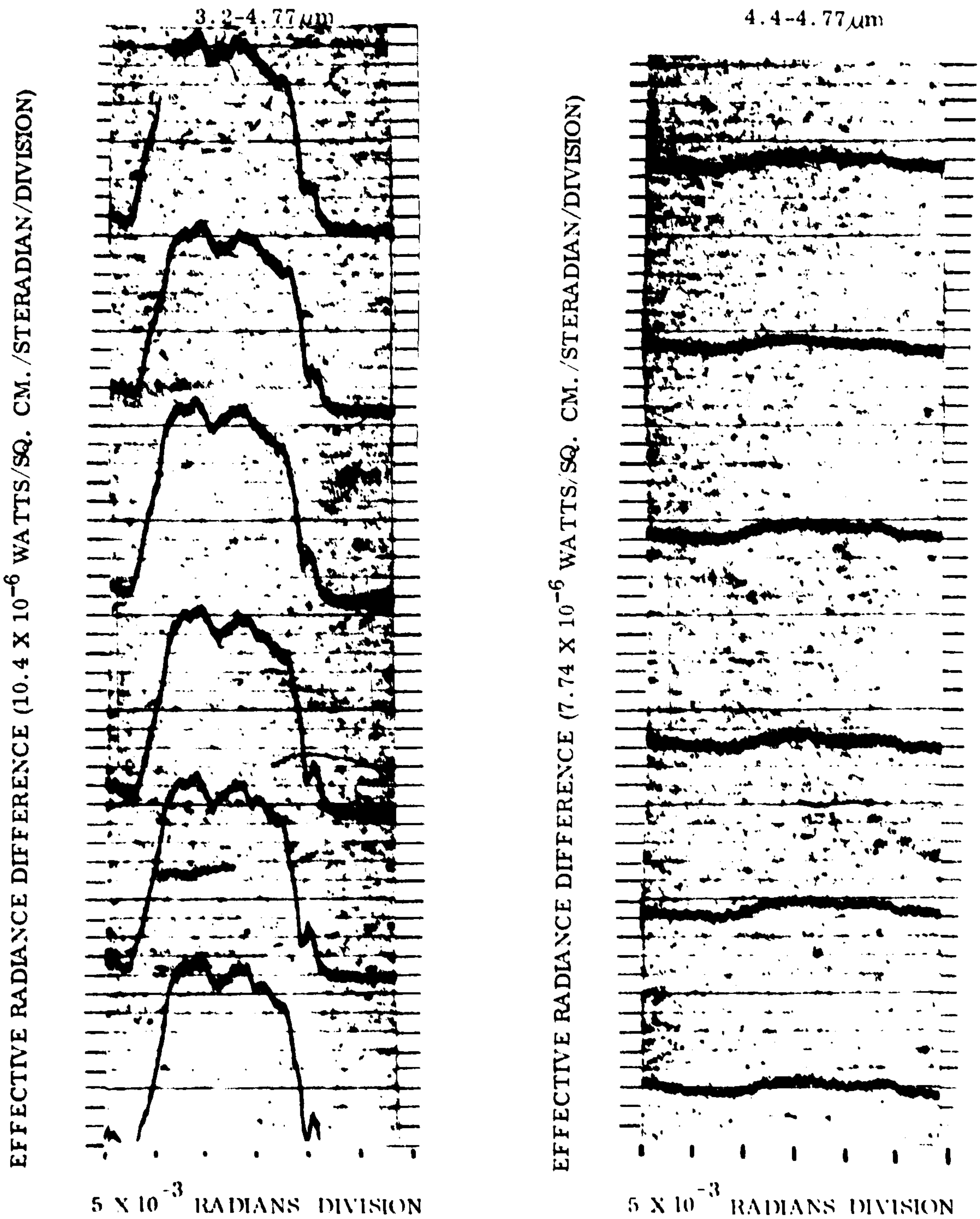

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 27

DATE: 4 MAY 1979
TIME: 15:35
TEMPERATURE: 82°F
RELATIVE HUMIDITY: 58%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 140°*
TARGET ELEVATION: 25°*
SUN TO TARGET ASPECT ANGLE: 102°*
CLOUD WAS TRACKED

* VALUES ESTIMATE FROM PHOTOGRAPH

TARGET 27



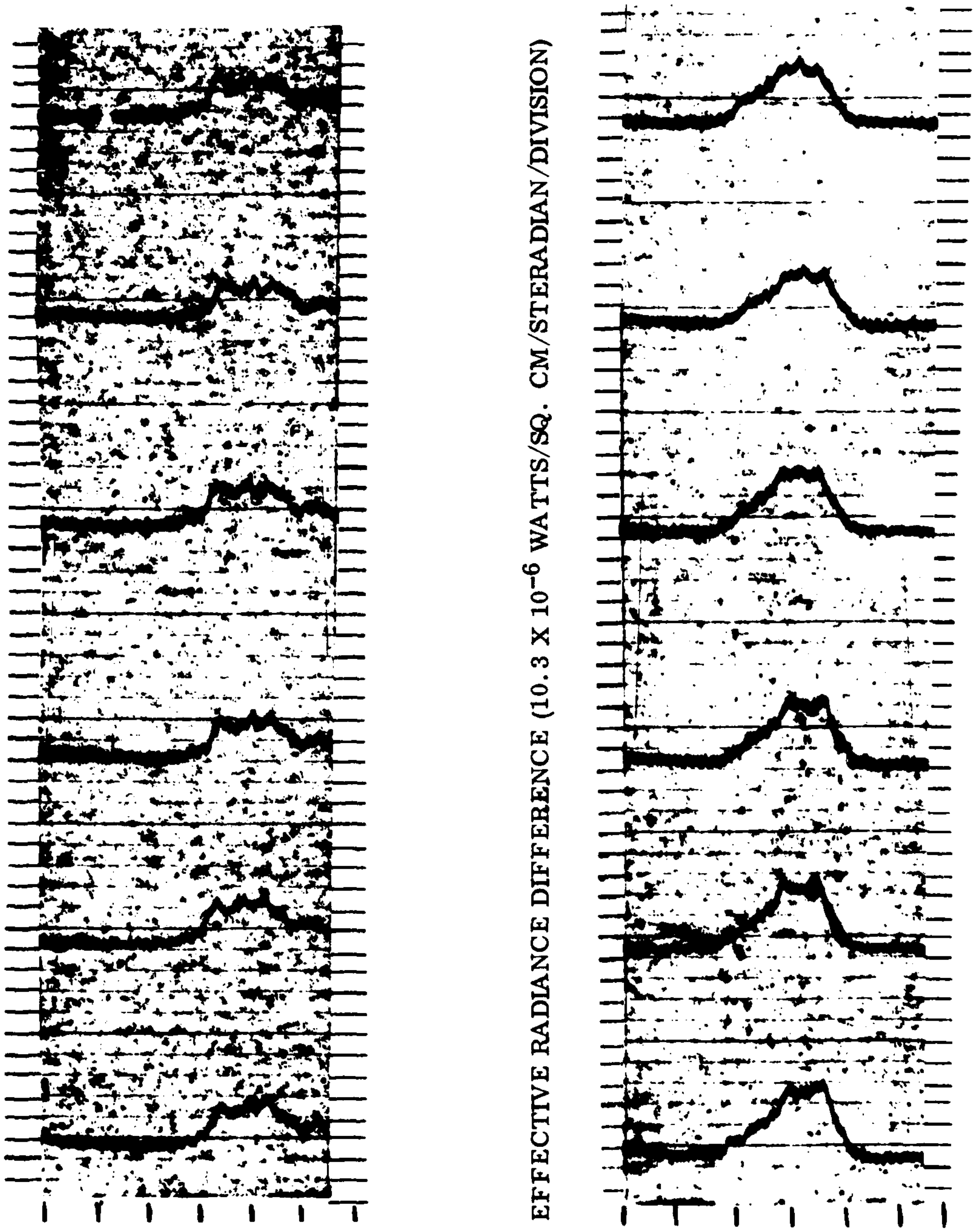
3.2-4.77 μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION
4.4-4.77 μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION

TARGET 27

3.8-4.2 μm 3.4-4.3 μm

EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^{-6} WATTS/SQ. CM./STERADIAN DIVISION)

EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^{-6} WATTS/SQ. CM/STERADIAN/DIVISION)

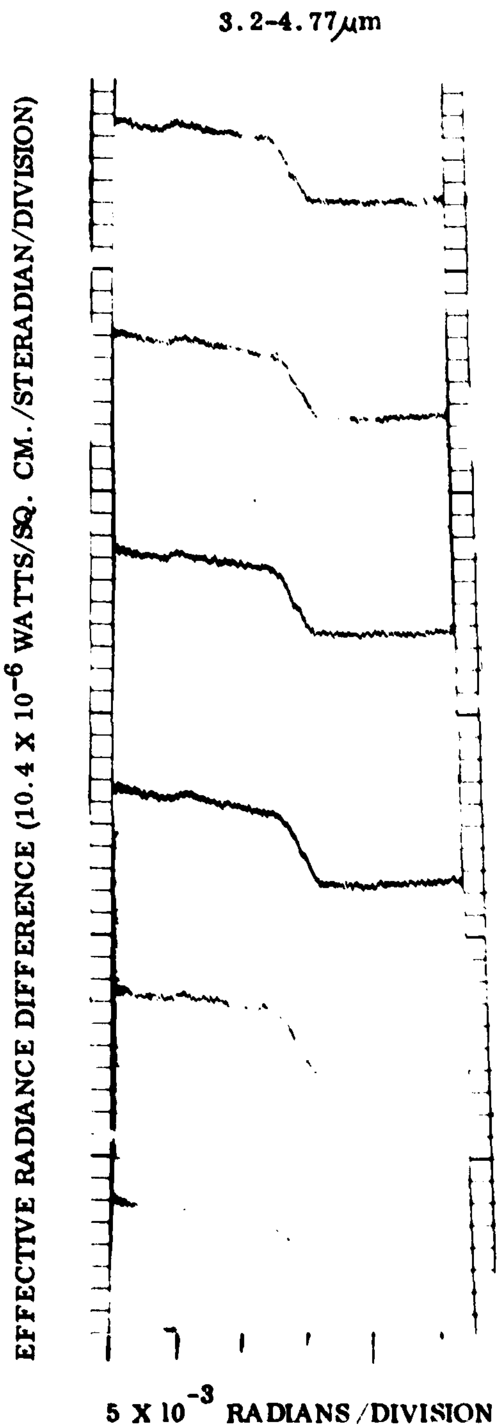


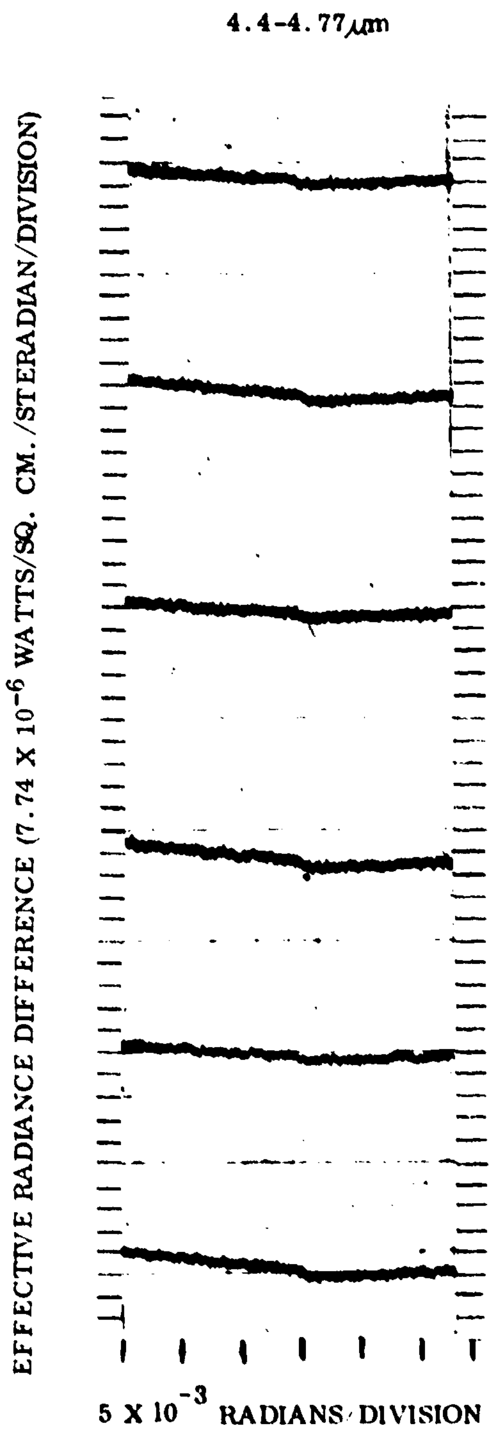
5 X 10^{-3} RADIANS/DIVISION 5 X 10^{-3} RADIANS/DIVISION

TARGET 28

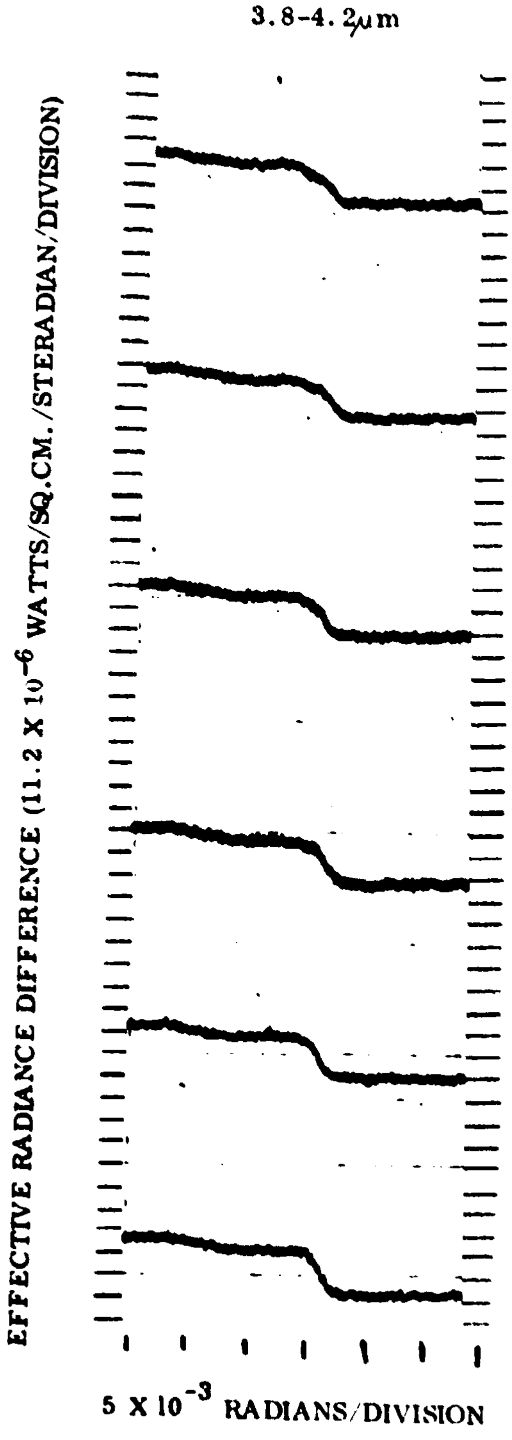
DATE: 4 MAY 1979
TIME: 15:42
TEMPERATURE: 82°F
RELATIVE HUMIDITY: 58%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 308°
TARGET ELEVATION: 9.1°
SUN TO TARGET ASPECT ANGLE: 58°
CLOUD WAS TRACKED

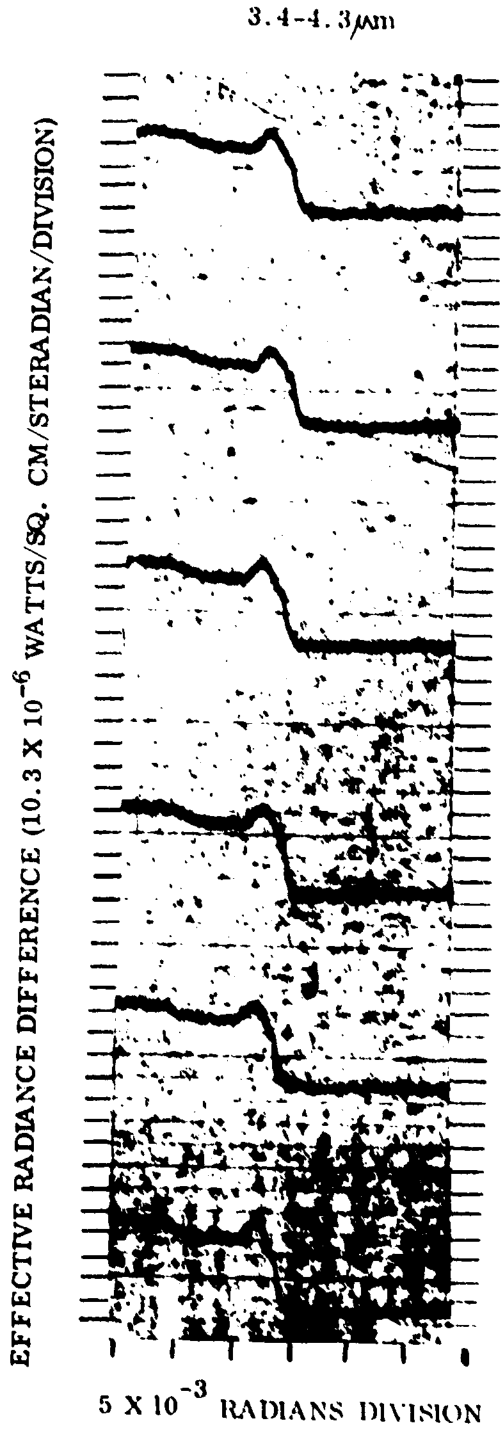
TARGET 28


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^{-6} WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^{-3} RADIANS/DIVISION


4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^{-6} WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^{-3} RADIANS/DIVISION

TARGET 28


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^{-6} WATTS/SQ.CM./STERADIAN/DIVISION)
5 X 10^{-3} RADIANS/DIVISION

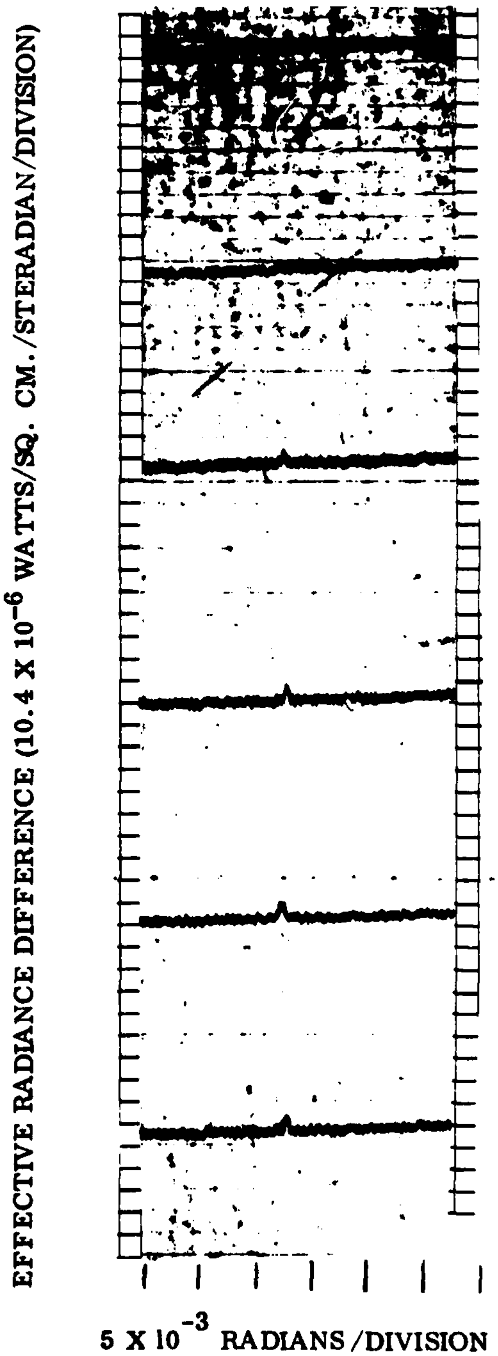

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^{-6} WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^{-3} RADIANS DIVISION

TARGET 31

DATE: 5 MAY 1979
TIME: 9:10
TEMPERATURE: 81^{o}F
RELATIVE HUMIDITY: 62%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 108^{o}
TARGET ELEVATION: 1.0^{o}
SUN TO TARGET ASPECT ANGLE: 45^{o}
MICROWAVE TOWER

TARGET 31

3.2-4.77μm



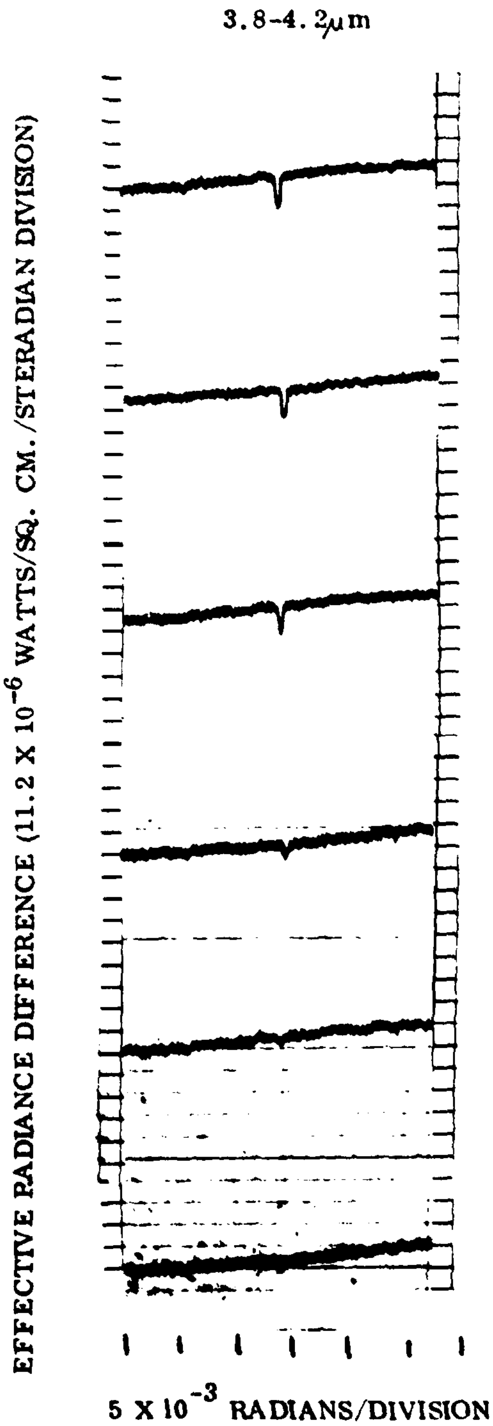
4.4-4.77μm

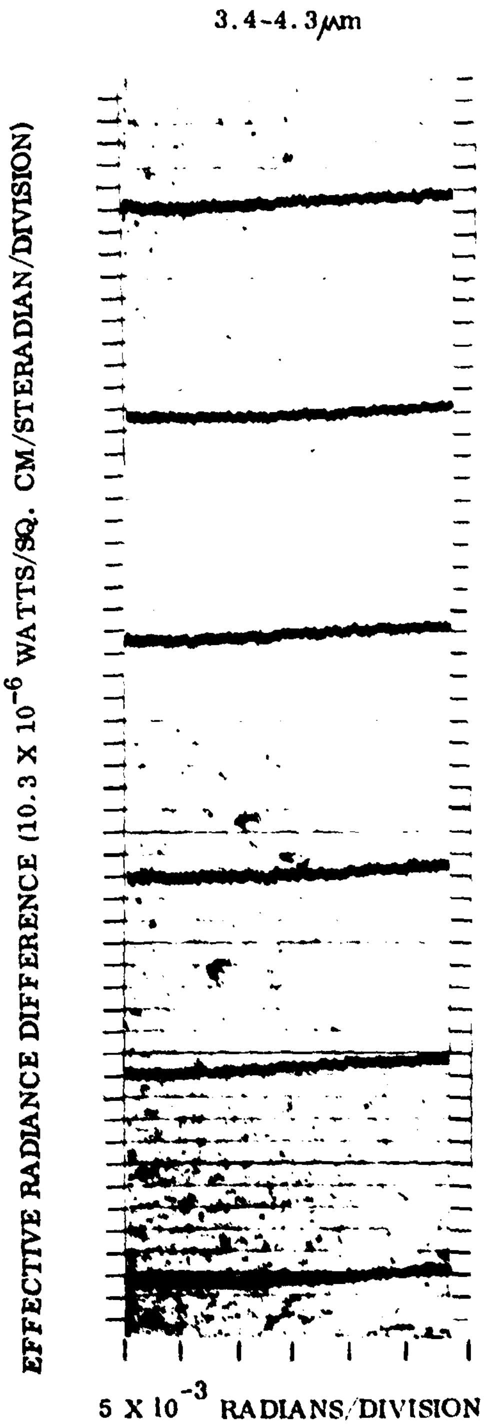
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^{-6} WATTS/SQ. CM./STERADIAN/DIVISION)

DATA NOT
AVAILABLE

5 X 10^{-3} RADIANS/DIVISION

TARGET 31

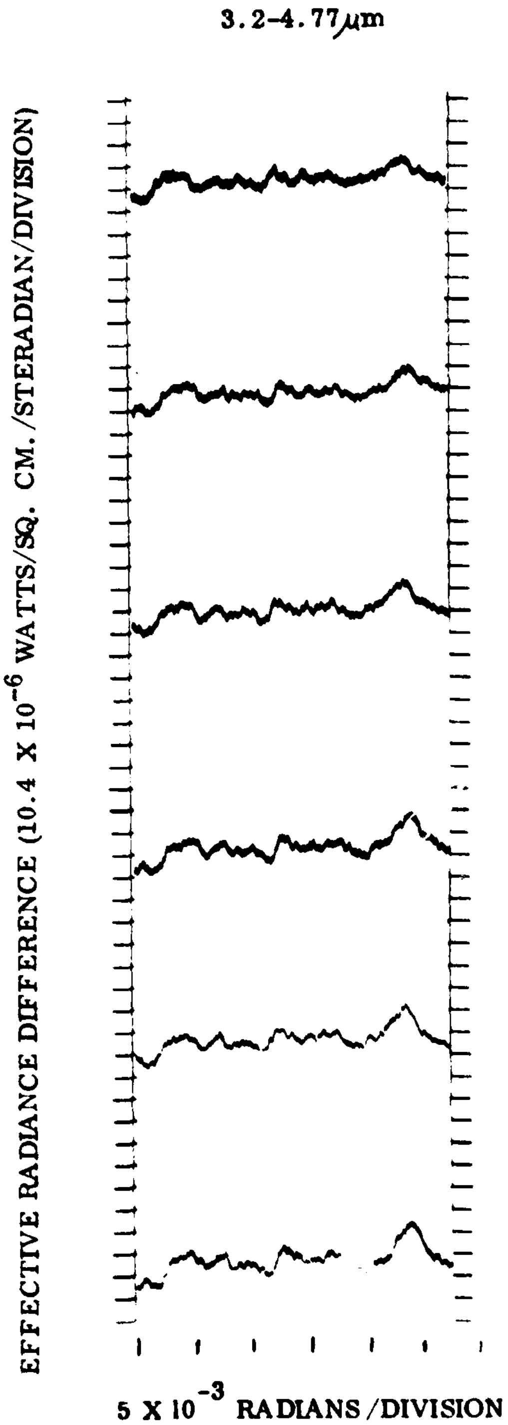

3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

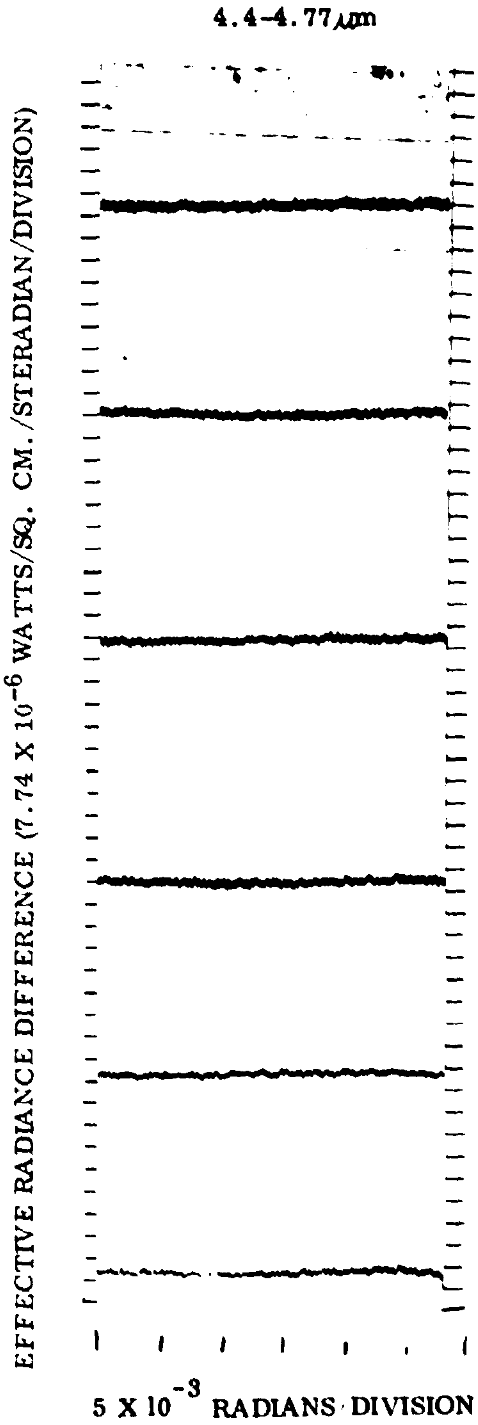

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 32

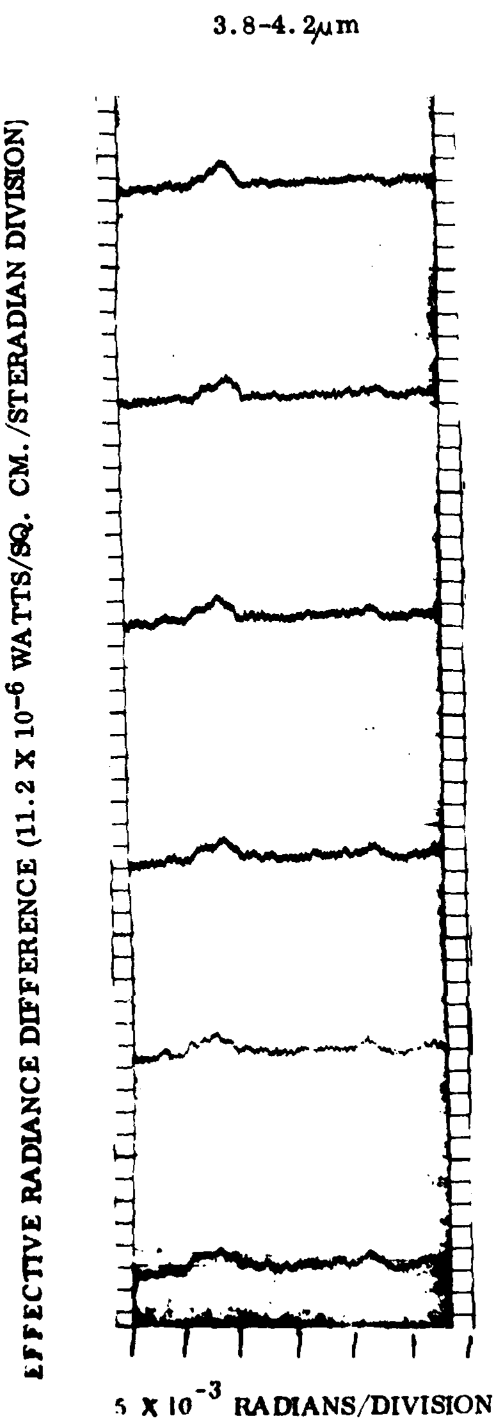
DATE: 5 MAY 1979
TIME: 9:25
TEMPERATURE: 82°F
RELATIVE HUMIDITY: 62%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 84°
TARGET ELEVATION: 1.9°
SUN TO TARGET ASPECT ANGLE: 46°

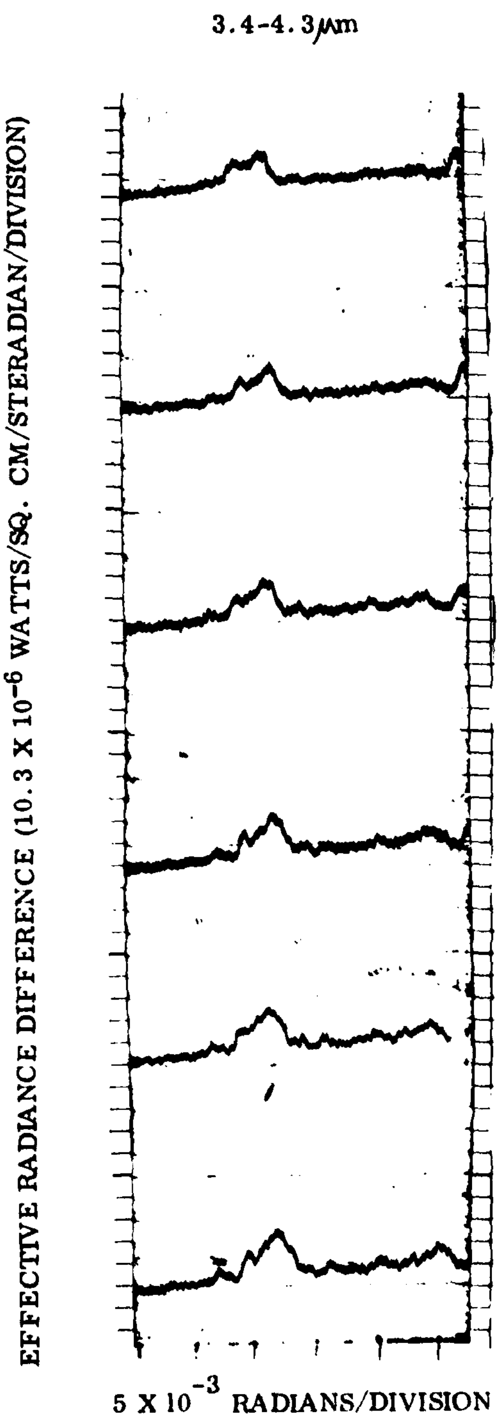
TARGET 32


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION


4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION

TARGET 32

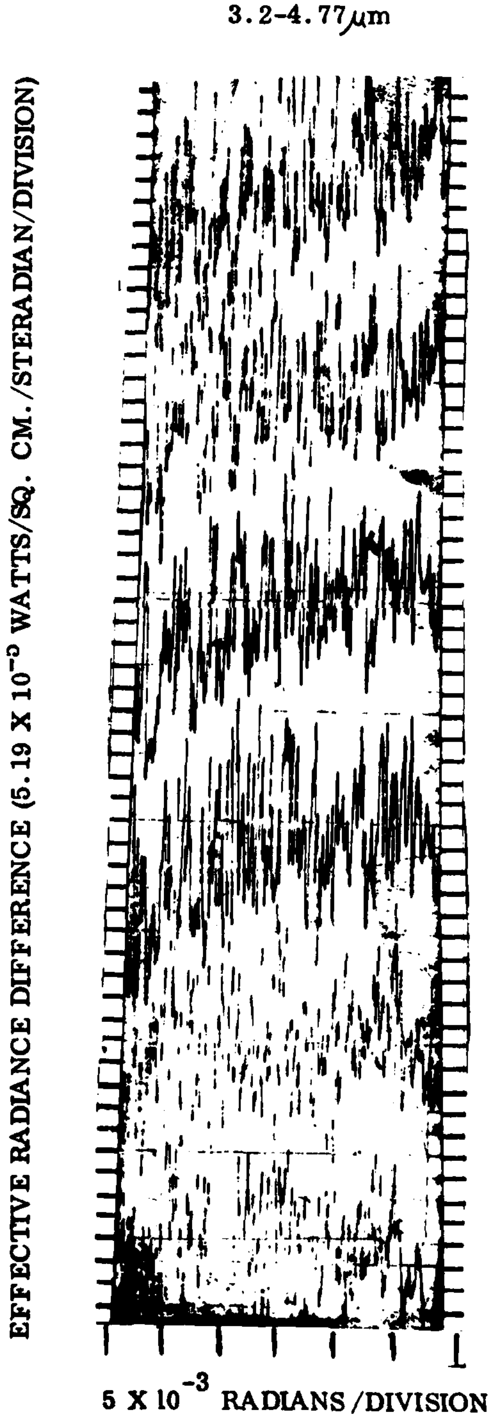

3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^{-6} WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^{-3} RADIANS/DIVISION

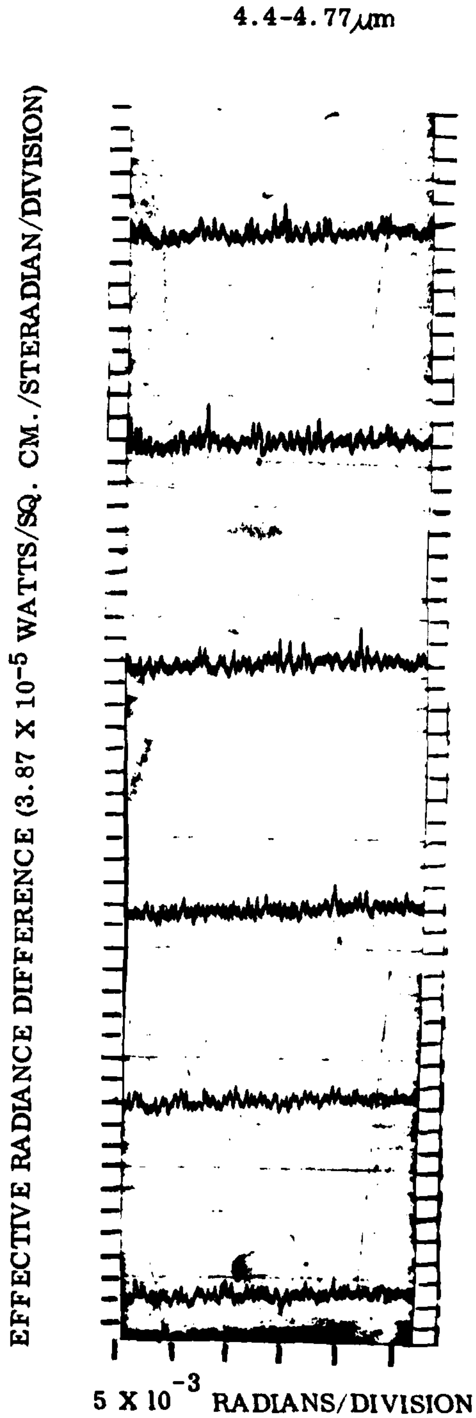

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^{-6} WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^{-3} RADIANS/DIVISION

TARGET 33

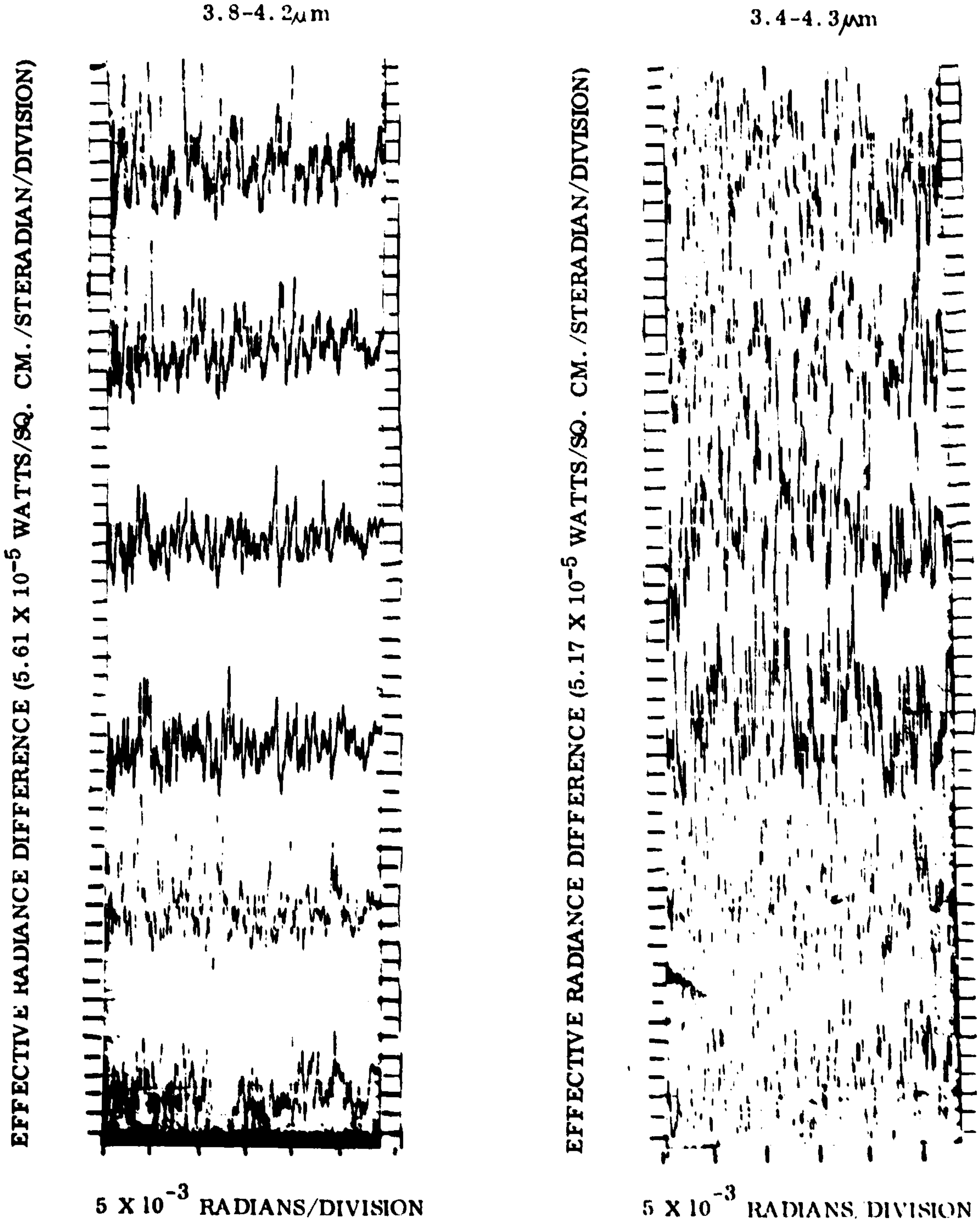
DATE: 5 MAY 1979
TIME: 9:30
TEMPERATURE: 82°F
RELATIVE HUMIDITY: 62%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 87°
TARGET ELEVATION: -0.15°
SUN TO TARGET ASPECT ANGLE: 31°
SOLAR GLINT

TARGET 33


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (5.19 X 10^{-5} WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^{-3} RADIANS/DIVISION


4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (3.87 X 10^{-5} WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^{-3} RADIANS/DIVISION

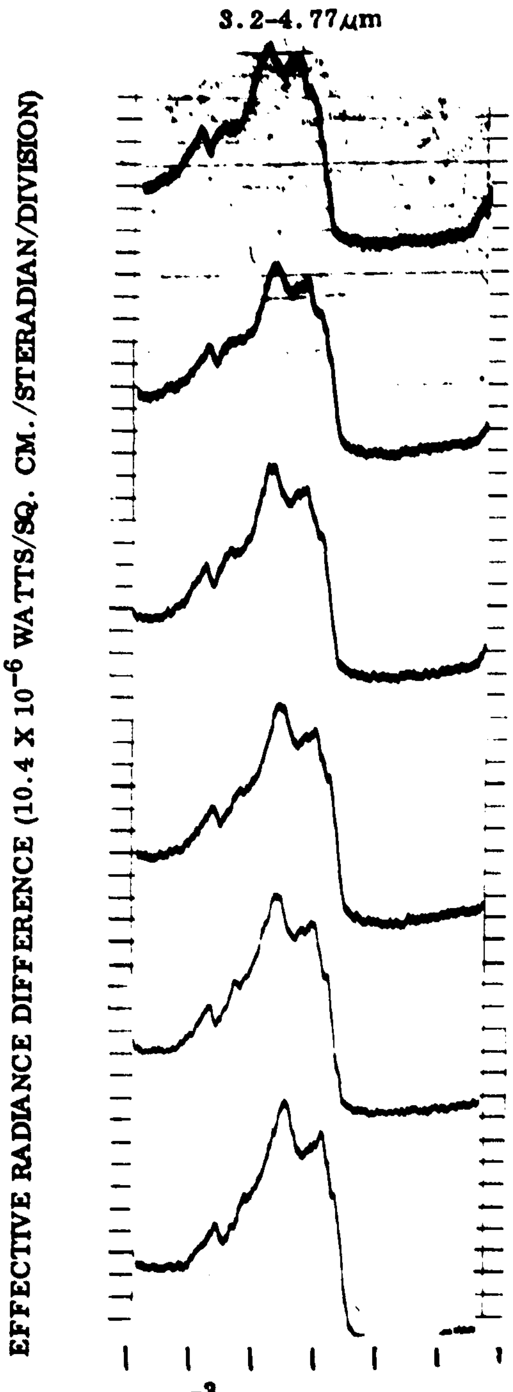
TARGET 33

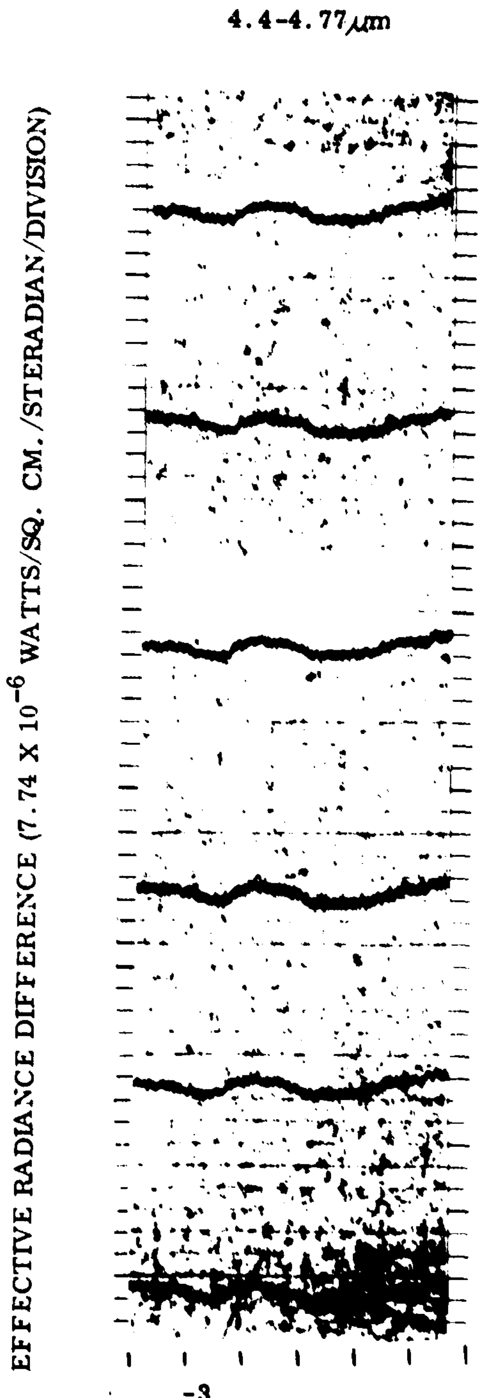

3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (5.61 X 10^-5 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION
3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (5.17 X 10^-5 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 35

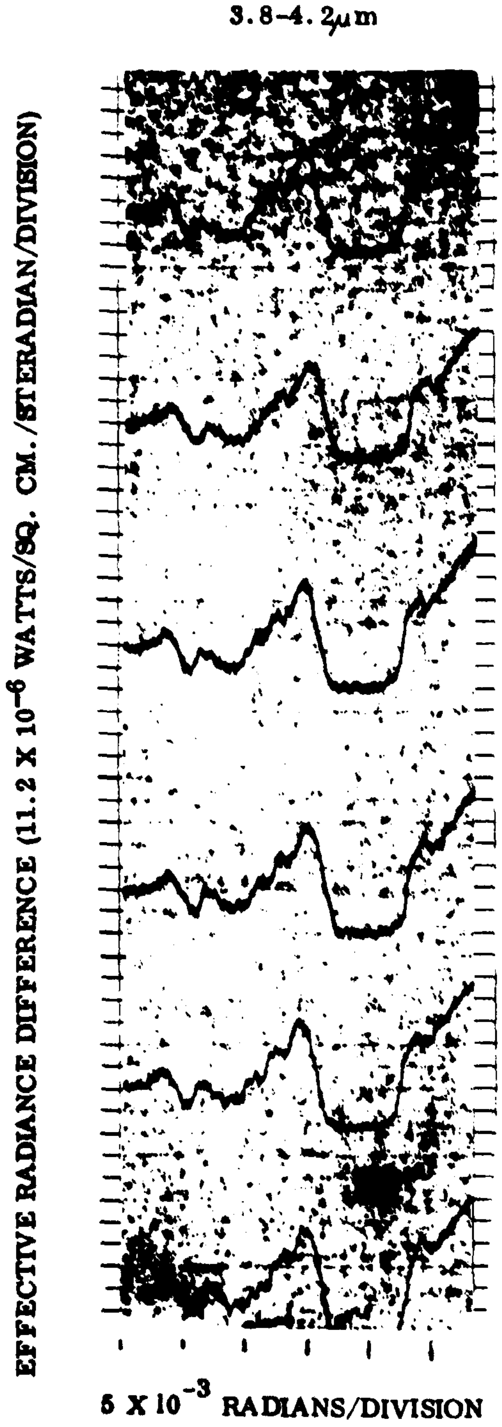
DATE: 5 MAY 1979
TIME: 10:15
TEMPERATURE: 83°F
RELATIVE HUMIDITY: 60%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 103°
TARGET ELEVATION: 9.5°
SUN TO TARGET ASPECT ANGLE: 46°
CLOUD WAS TRACKED

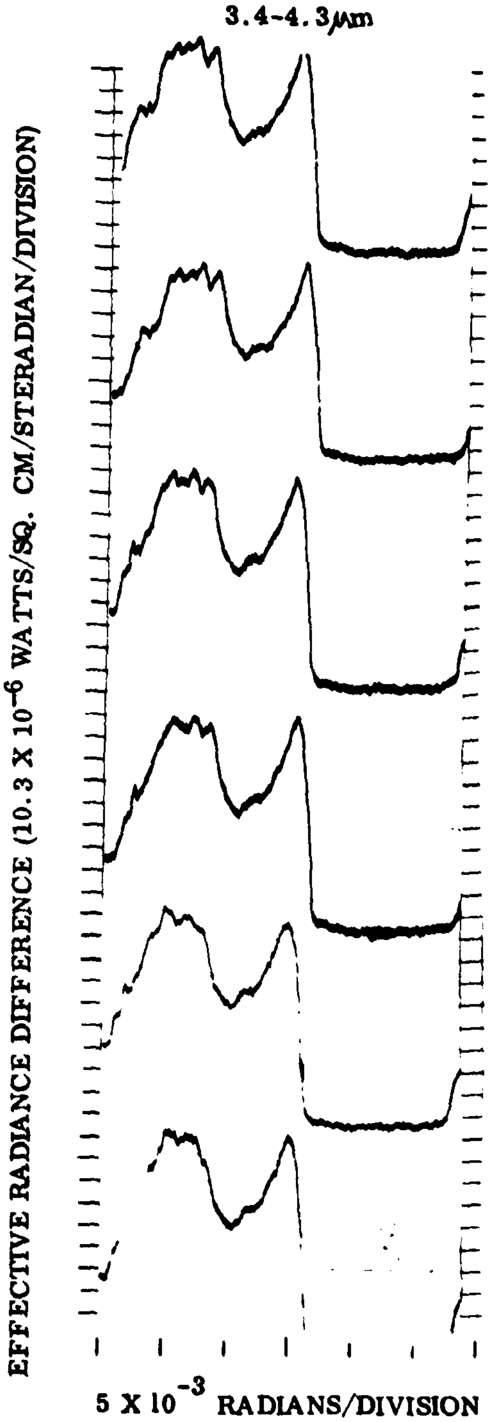
TARGET 35


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION


4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

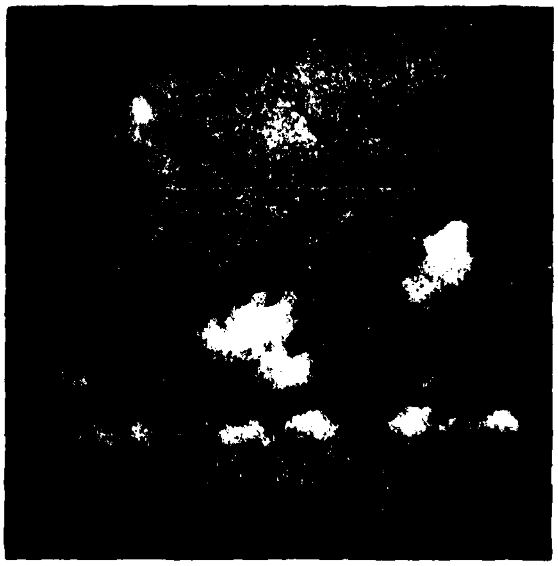
TARGET 35


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^{-6} WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^{-3} RADIANS/DIVISION

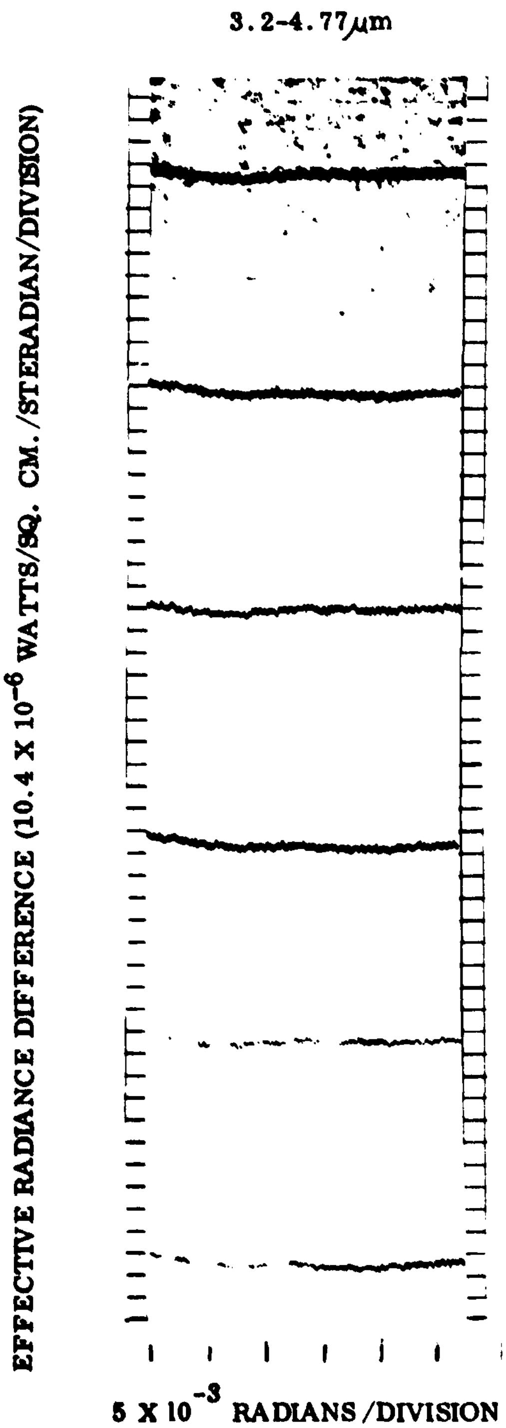

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^{-6} WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^{-3} RADIANS/DIVISION

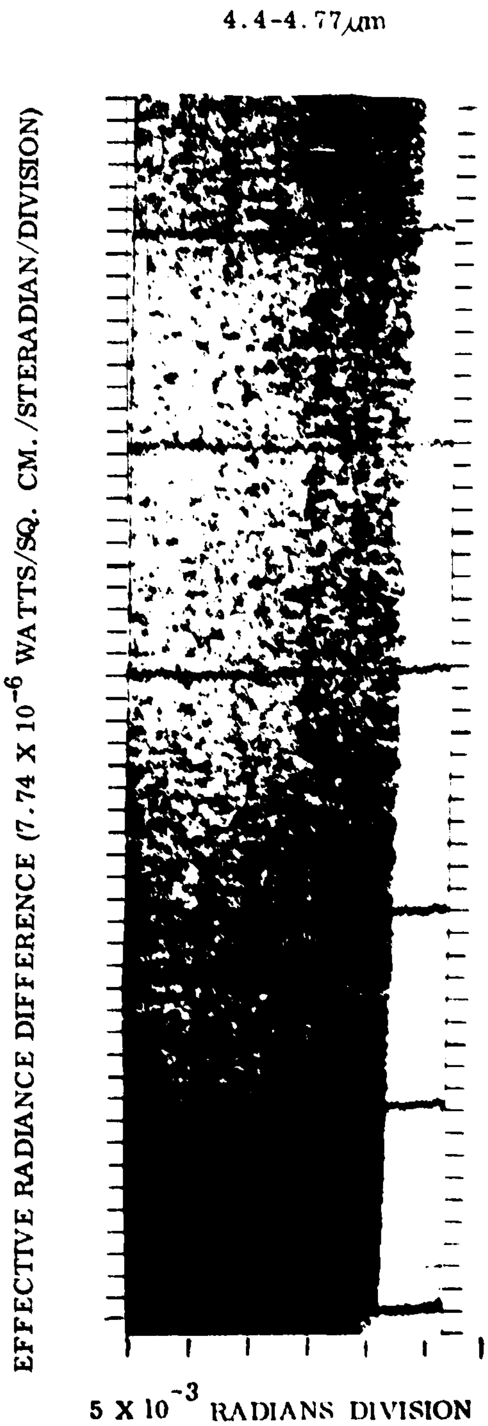
TARGET 36

DATE: 5 MAY 1979
TIME: 12:35
TEMPERATURE: 84°F
RELATIVE HUMIDITY: 60%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 10°
TARGET ELEVATION: 9.6°
SUN TO TARGET ASPECT ANGLE: 84°

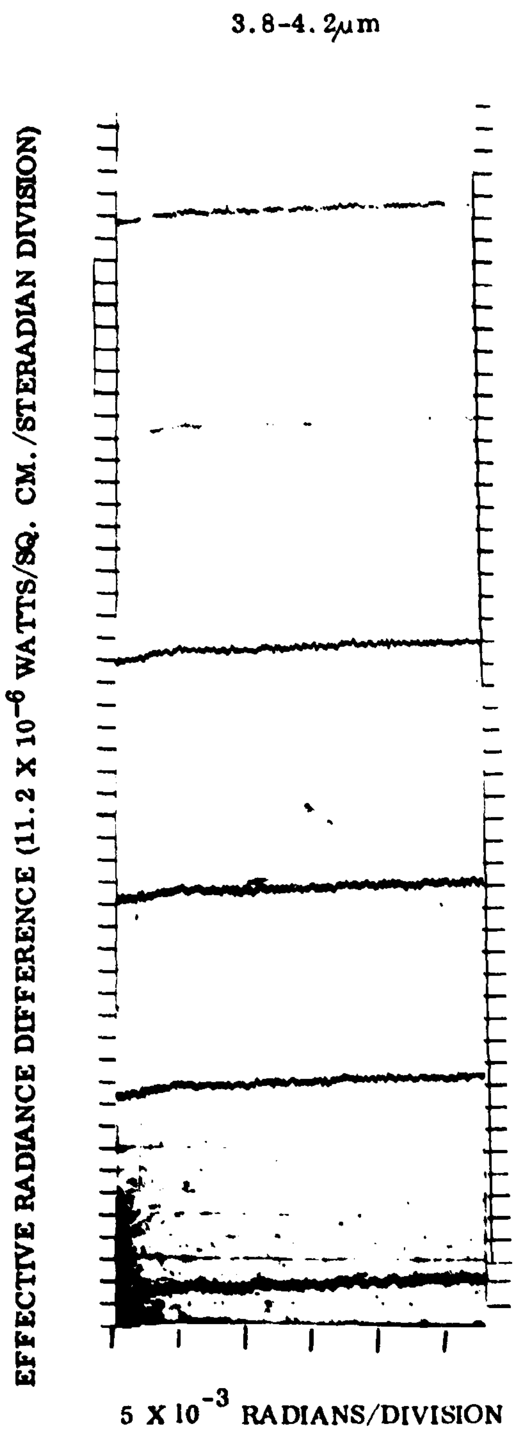


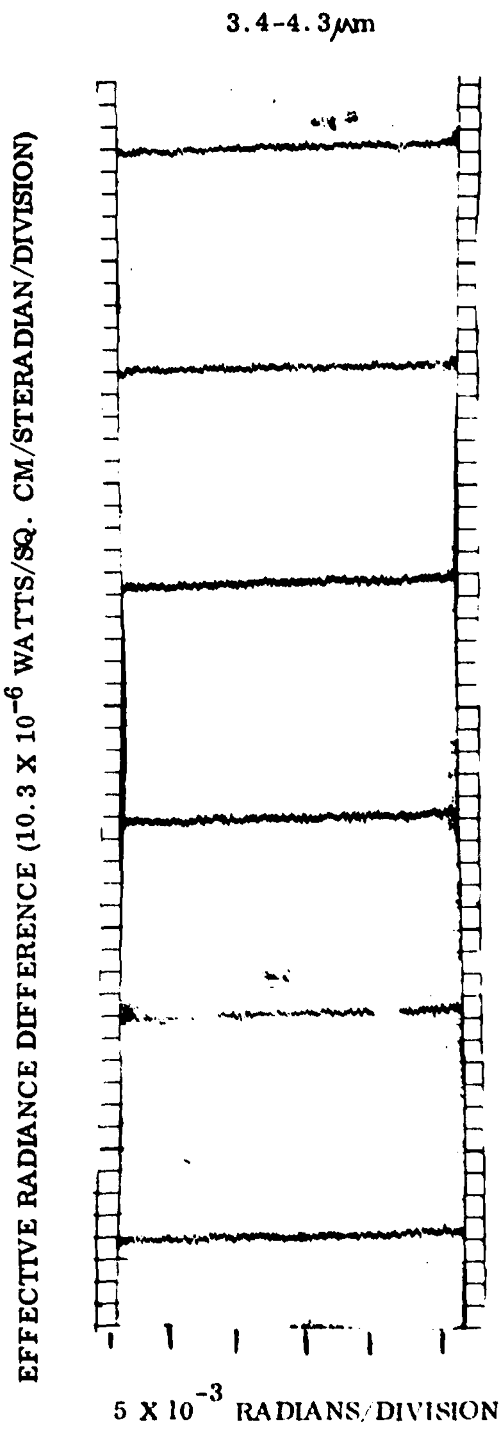
TARGET 36


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION


4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION

TARGET 36


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^{-6} WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^{-3} RADIANS/DIVISION

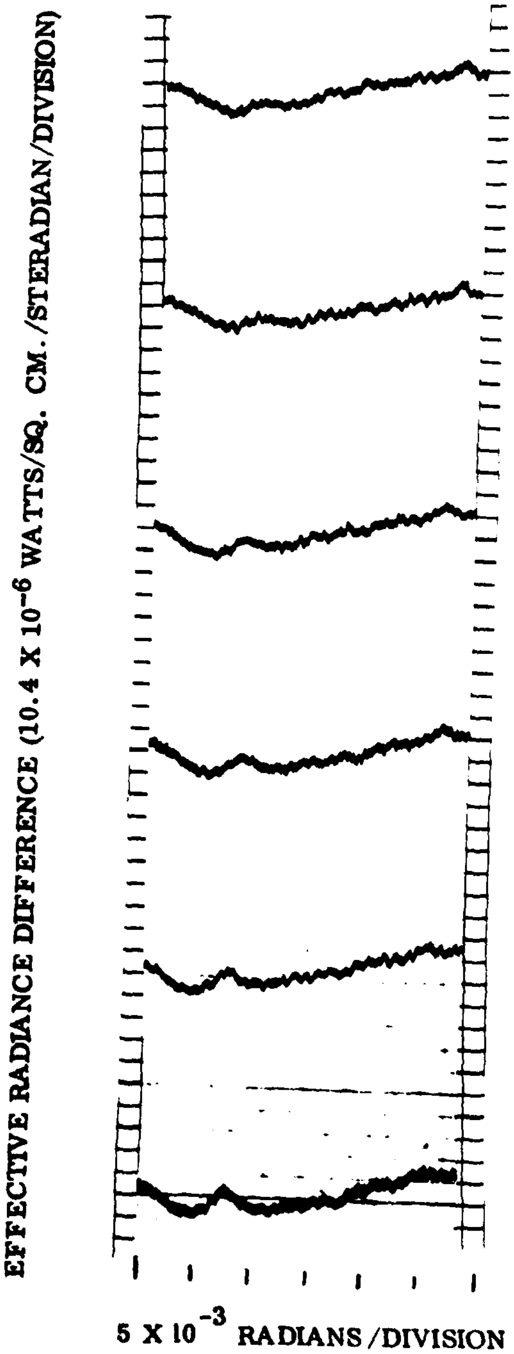

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^{-6} WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^{-3} RADIANS/DIVISION

TARGET 37

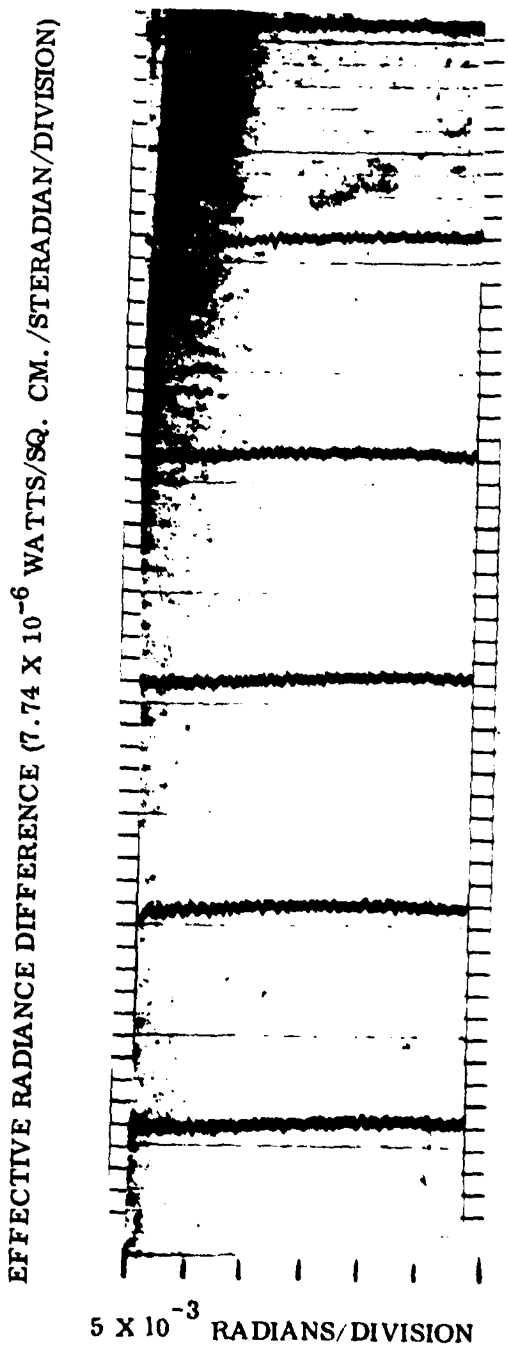
DATE: 8 MAY 1979
TIME: 9:24
TEMPERATURE: 81°F
RELATIVE HUMIDITY: 72%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 86°
TARGET ELEVATION: 8.6°
SUN TO TARGET ASPECT ANGLE: 36°

TARGET 37

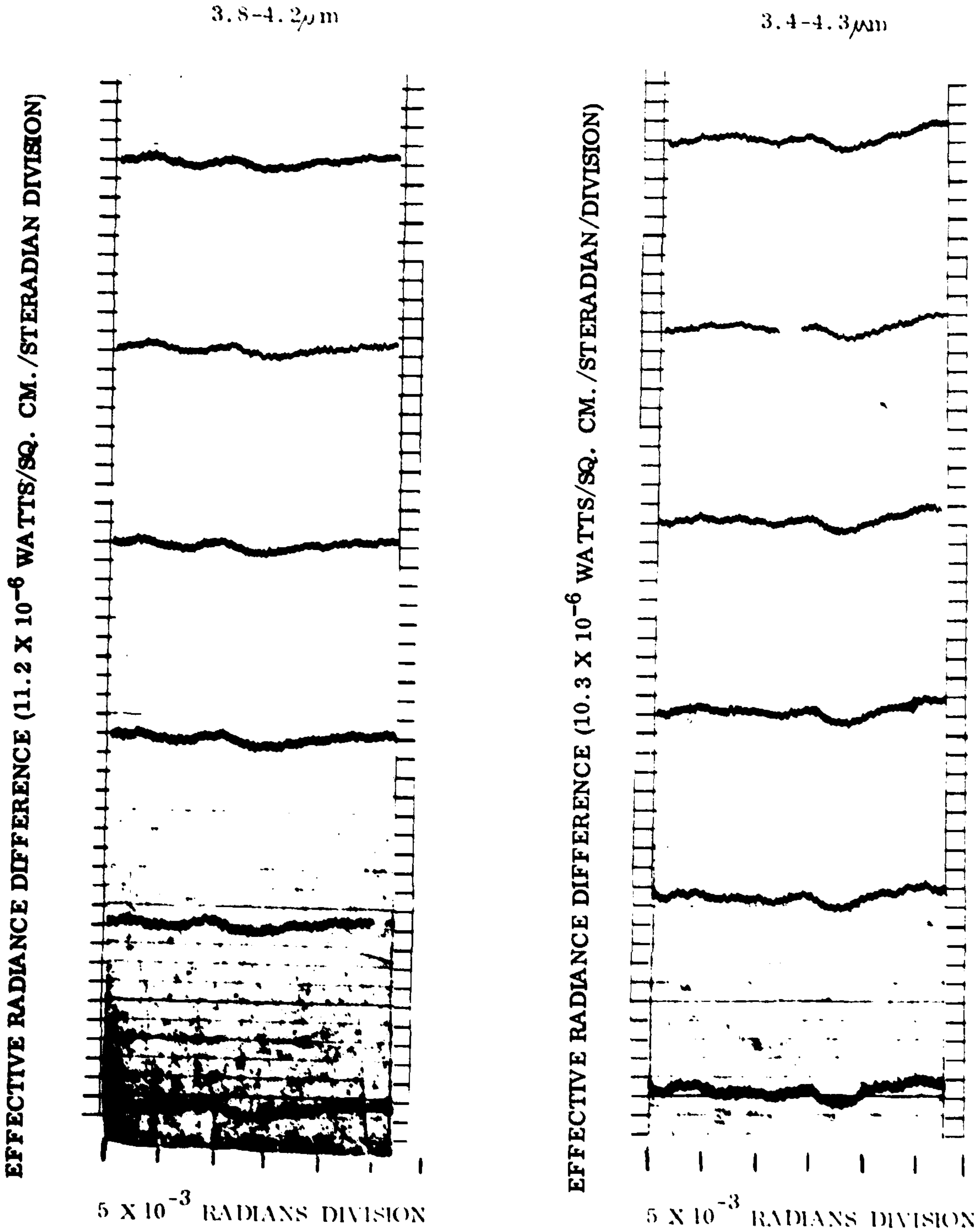
3.2-4.77 μm



4.4-4.77 μm



TARGET 37



3.8-4.2μm
3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION
5 X 10^-3 RADIANS DIVISION

TARGET 38

DATE: 8 MAY 1979
TIME: 9:31
TEMPERATURE: 81°F
RELATIVE HUMIDITY: 72%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 78°
TARGET ELEVATION: 8.6°
SUN TO TARGET ASPECT ANGLE: 38°

AD-A081 052 CINCINNATI ELECTRONICS CORP OH F/G 17/5
RADIOMETRIC MEASUREMENTS BY THE MIDAS III SYSTEM AT KEY WEST. V--ETC(U)
SEP 79 A GEISER, C DIPPEL, V O'CONNELL N60530-79-C-0031
UNCLASSIFIED CTR-79-0012 NL

2 OF 3
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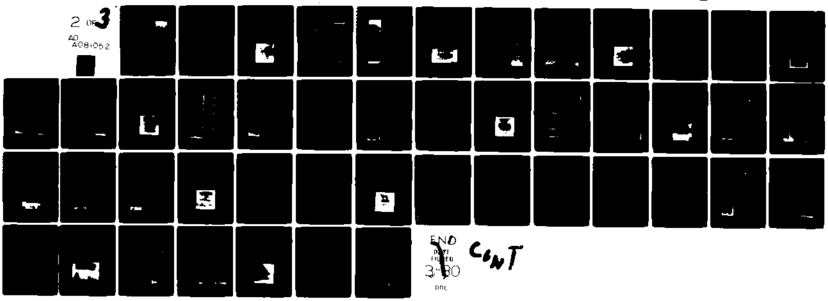
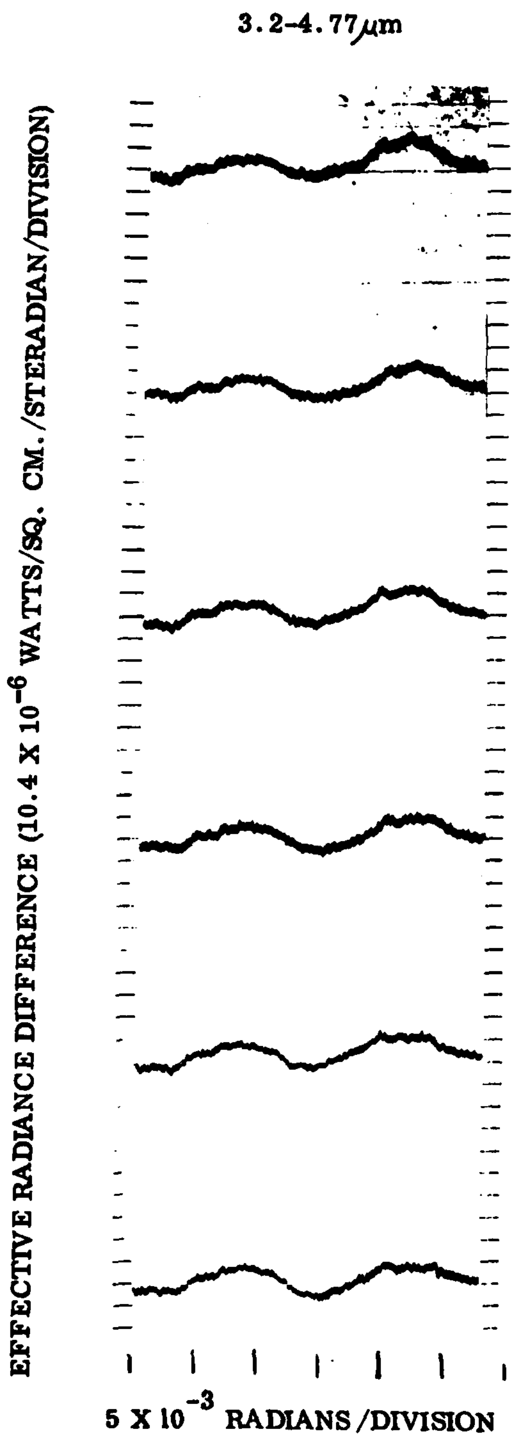
A081052

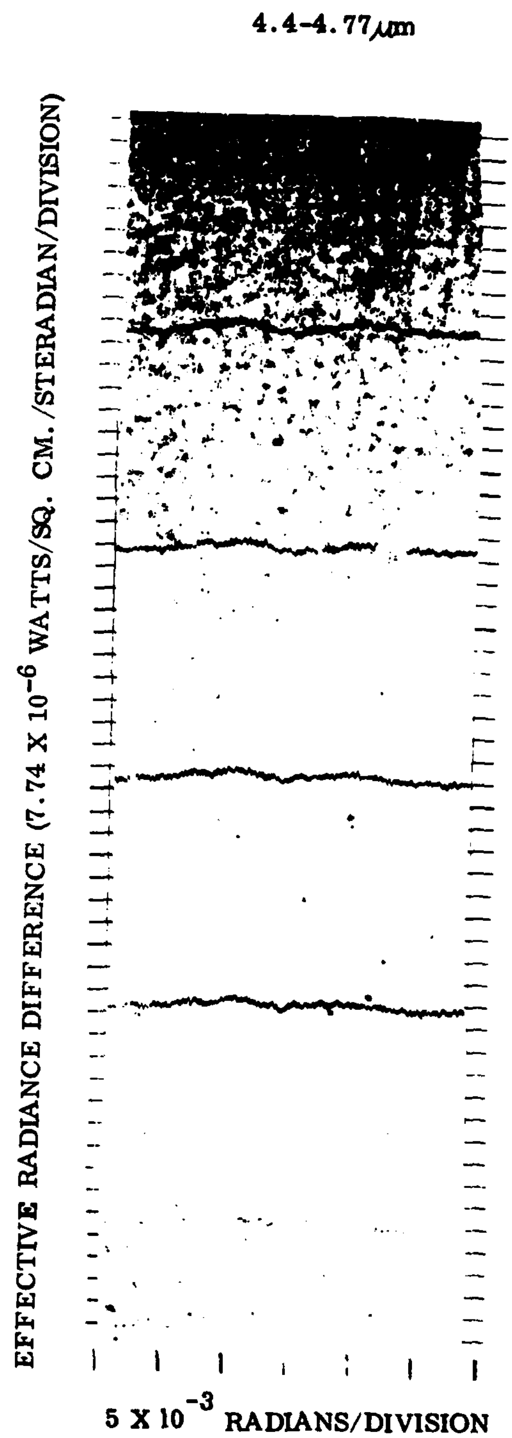


END
DATE
FILMED
3-80
DDC

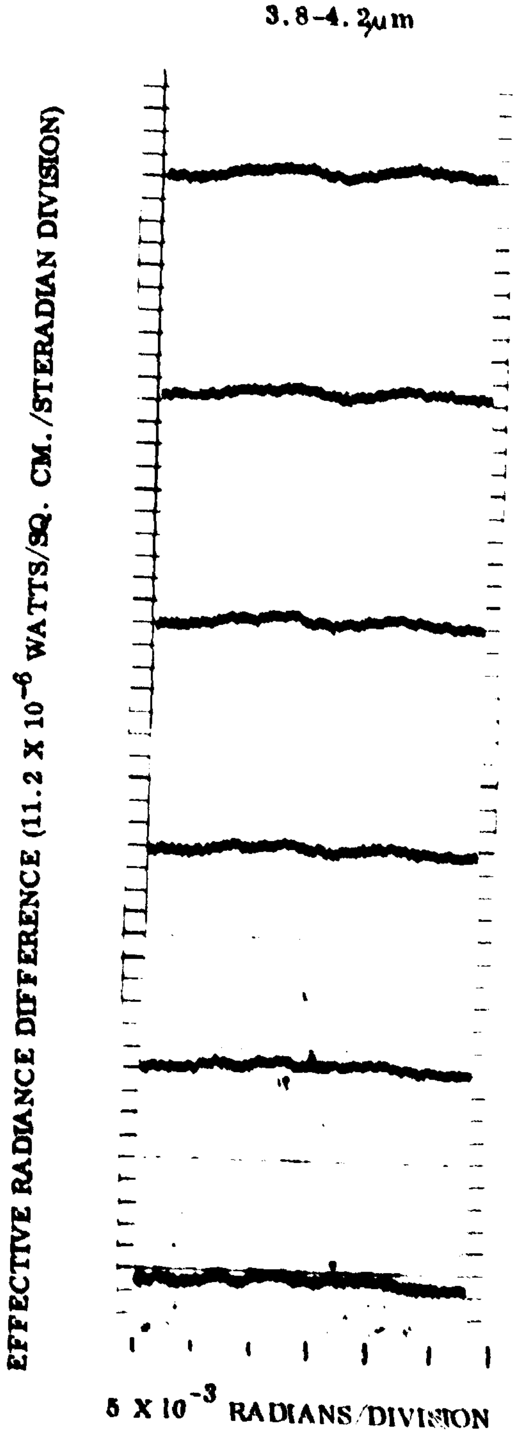
CONT

TARGET 38


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION


4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 38


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

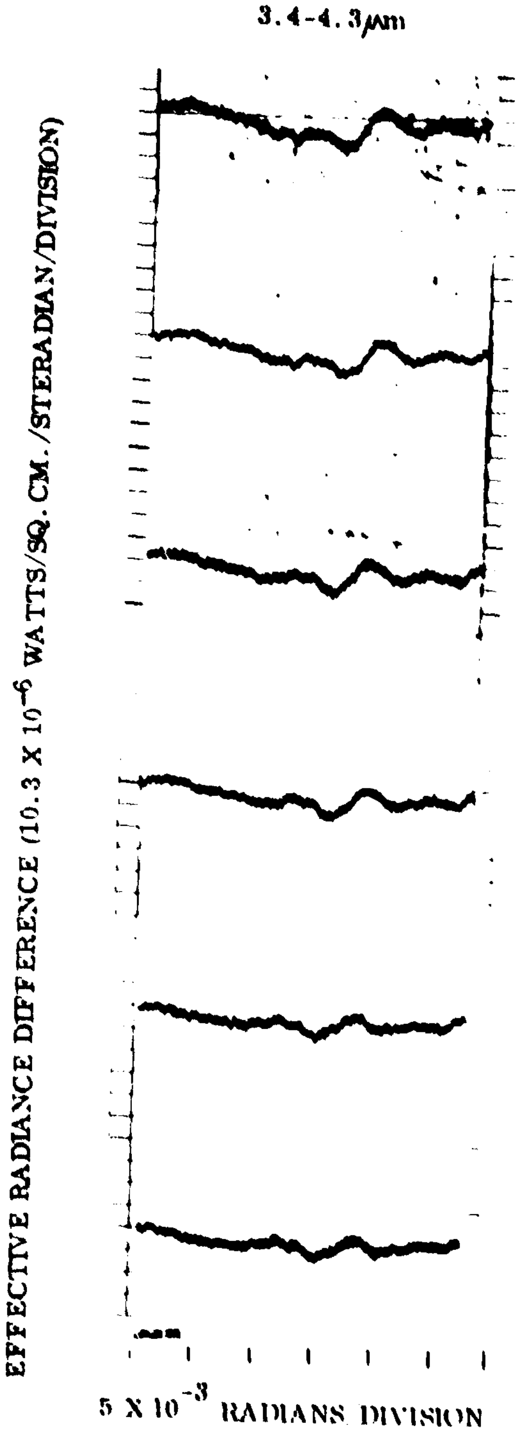
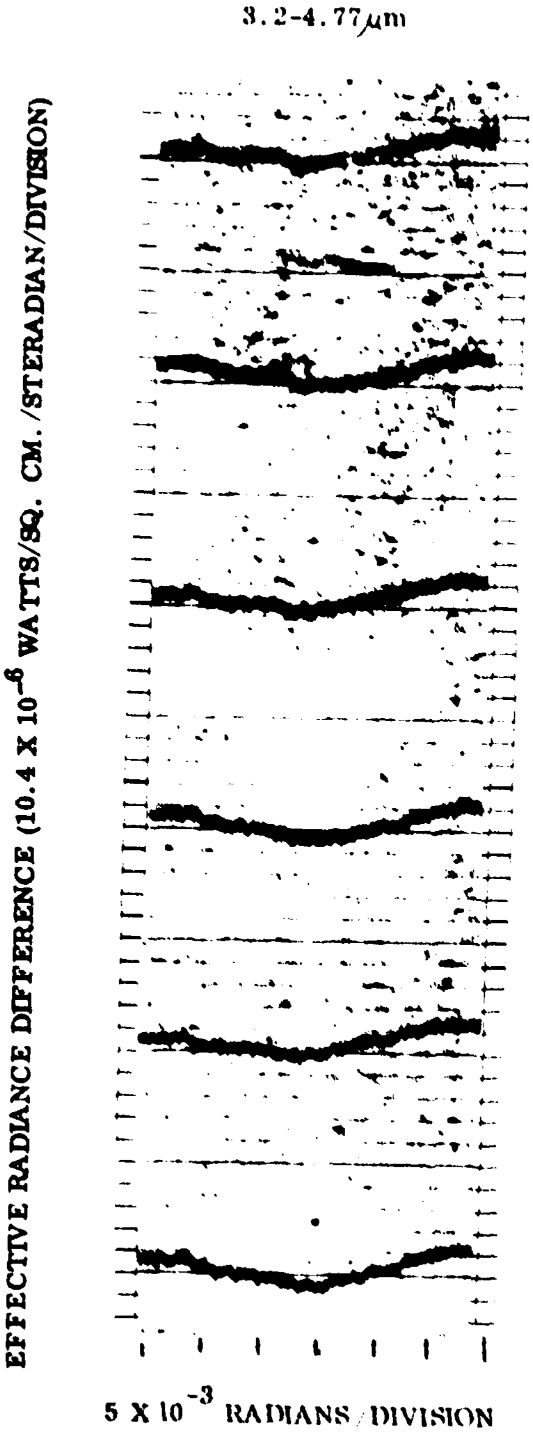

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION

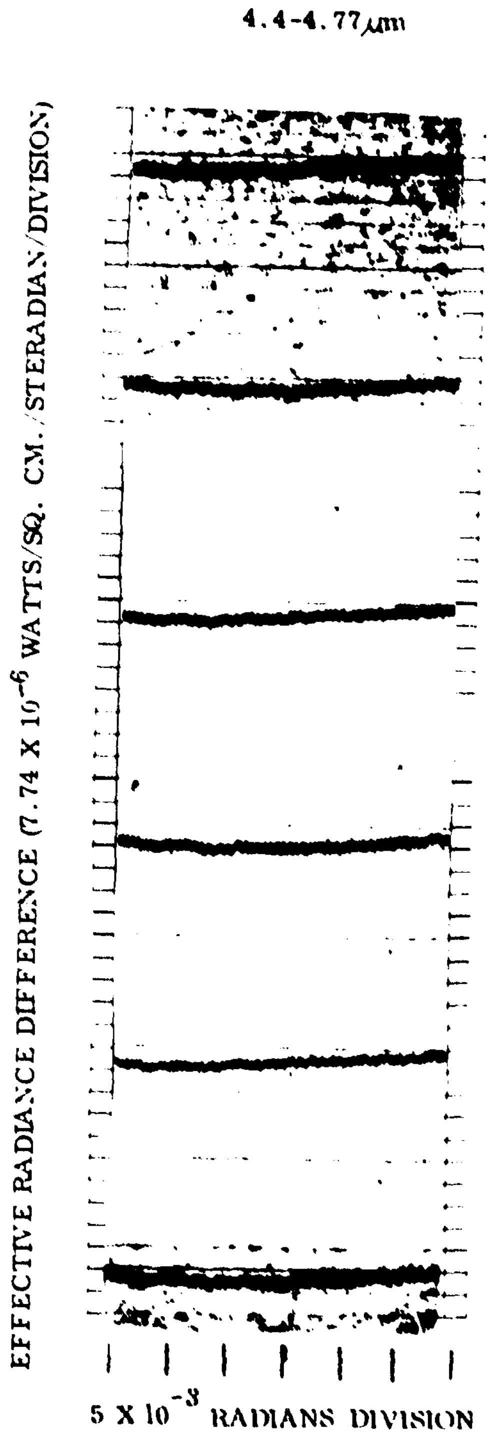
IMAGE F 39

DATE: 8 MAY 1979
TIME: 9:43
TEMPERATURE: 82°F
RELATIVE HUMIDITY: 72%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 3°
TARGET ELEVATION: 28.7°
SUN TO TARGET ASPECT ANGLE: 66°

TARGET 39

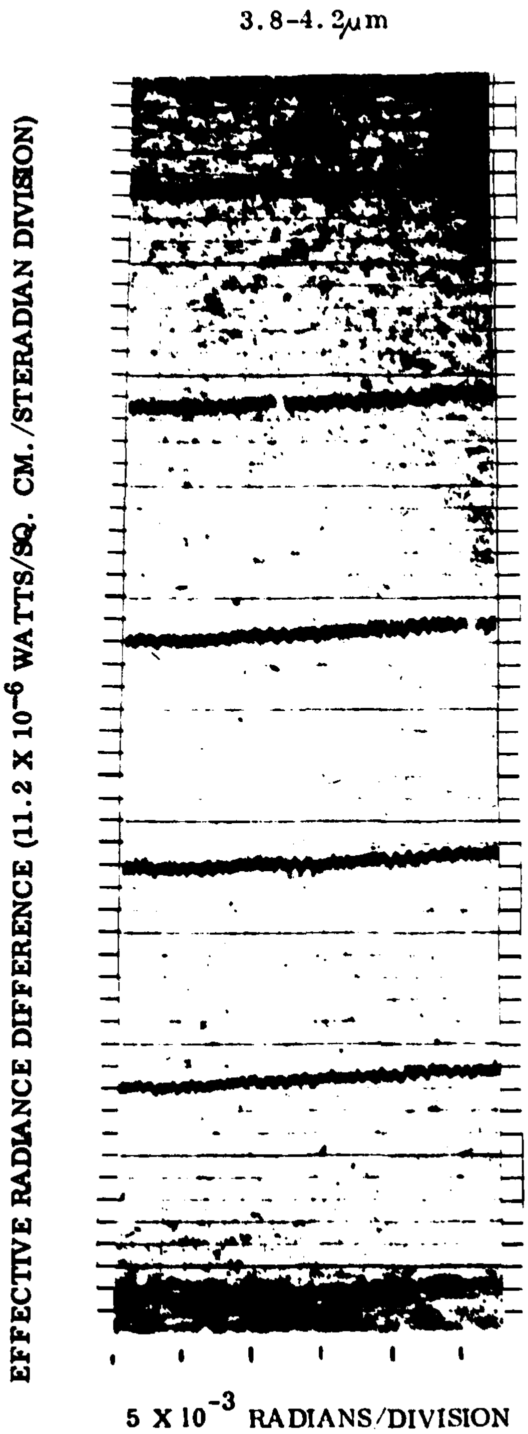


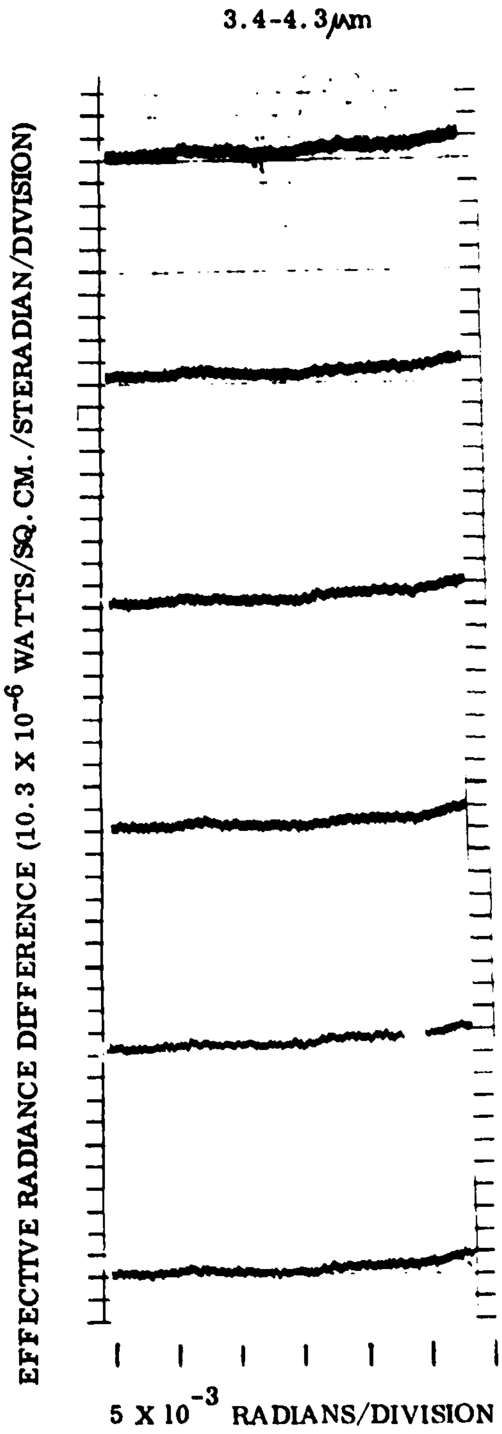
3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION



4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION

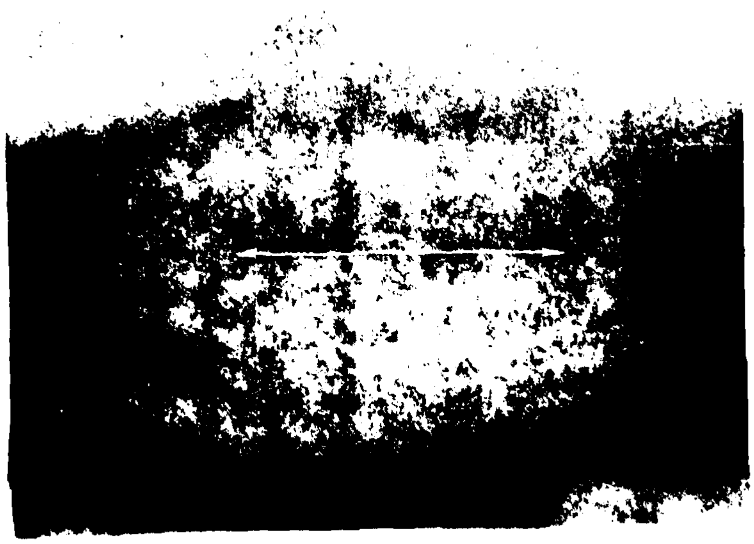
TARGET 39


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

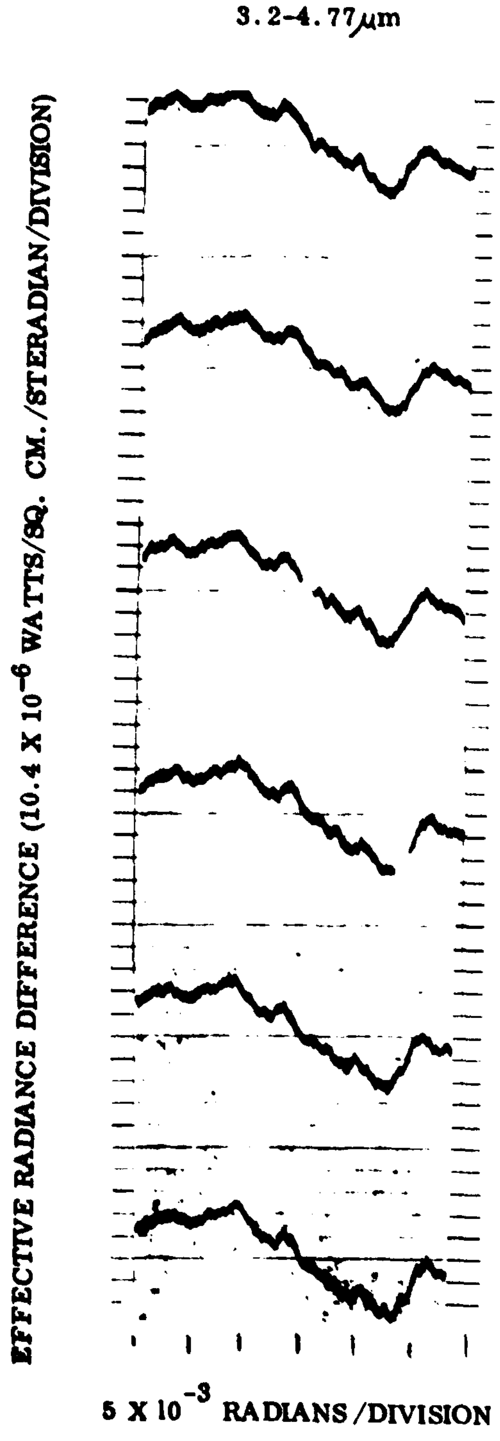

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

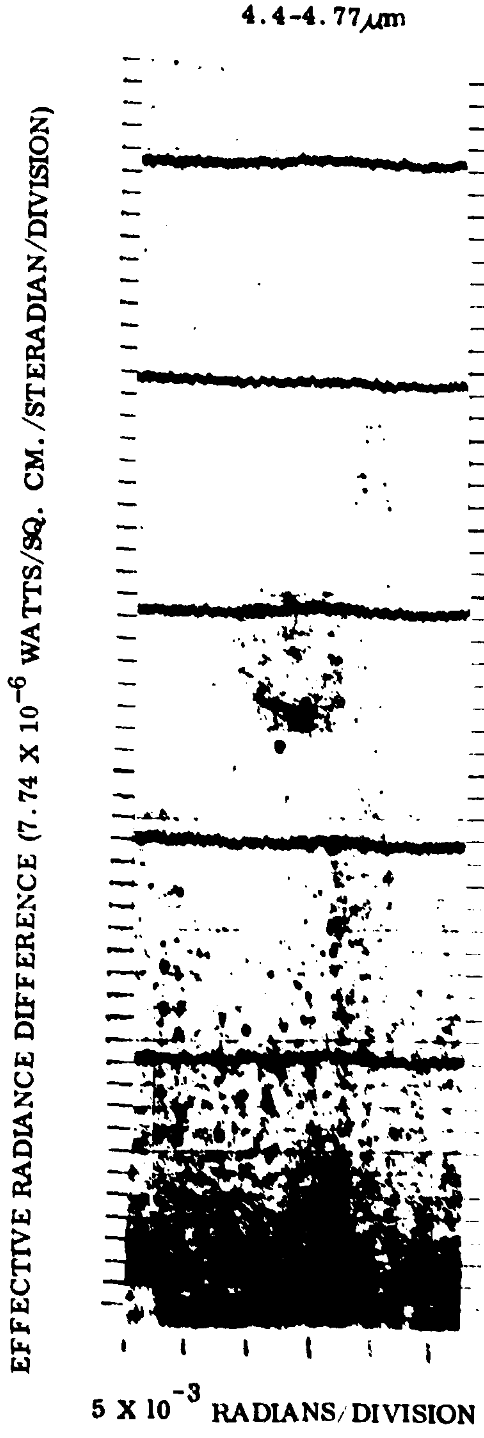
TARGET 40

DATE: 8 MAY 1979
TIME: 10:05
TEMPERATURE: 82^{o}F
RELATIVE HUMIDITY: 72%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 99^{o}
TARGET ELEVATION: 4.9^{o}
SUN TO TARGET ASPECT ANGLE: 49^{o}

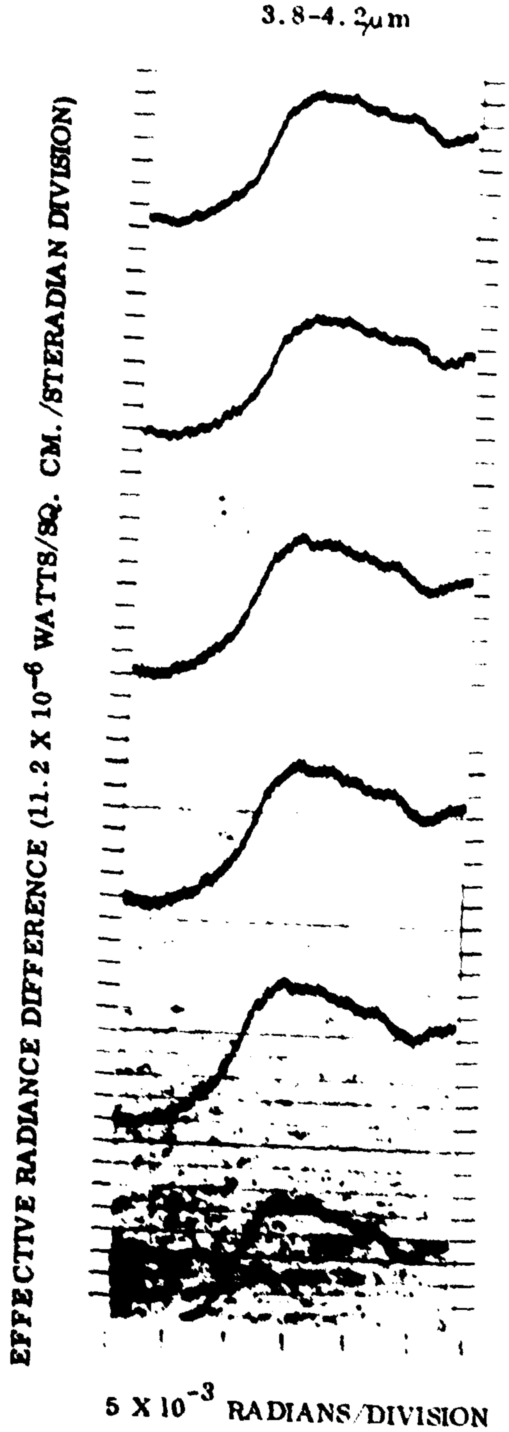


TARGET 40

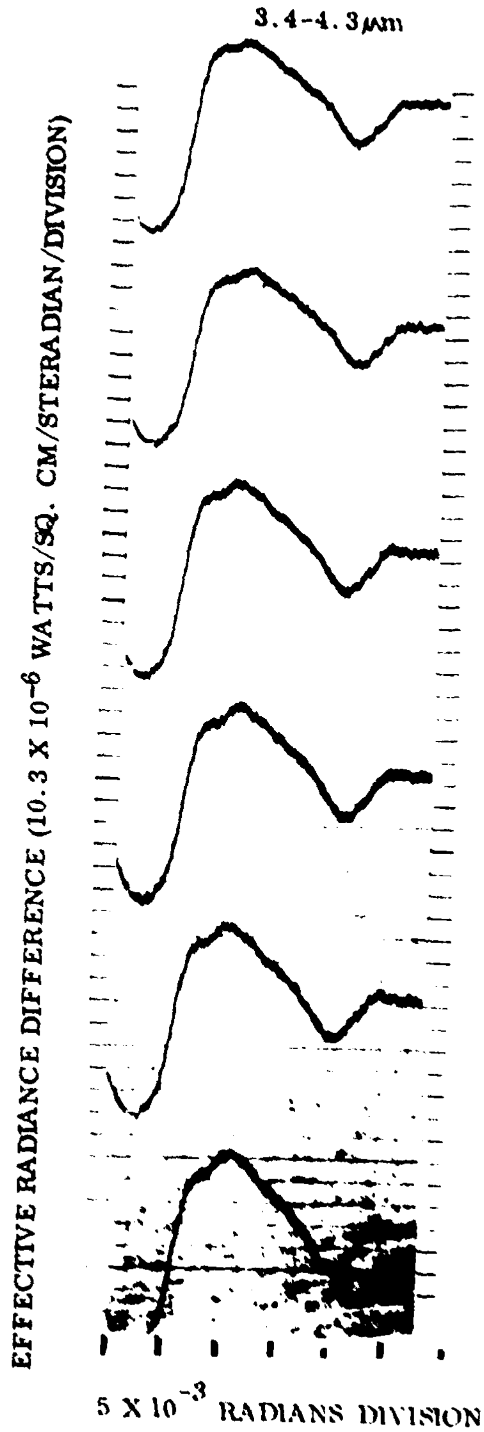

3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION


4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 40



3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION



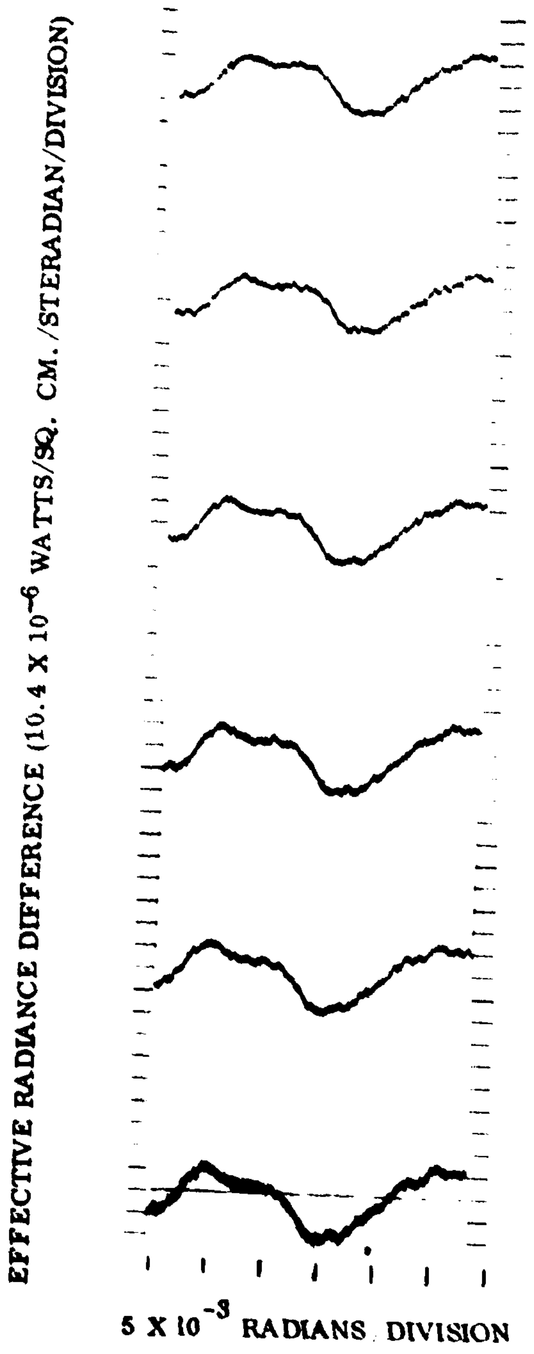
3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION

TARGET 41

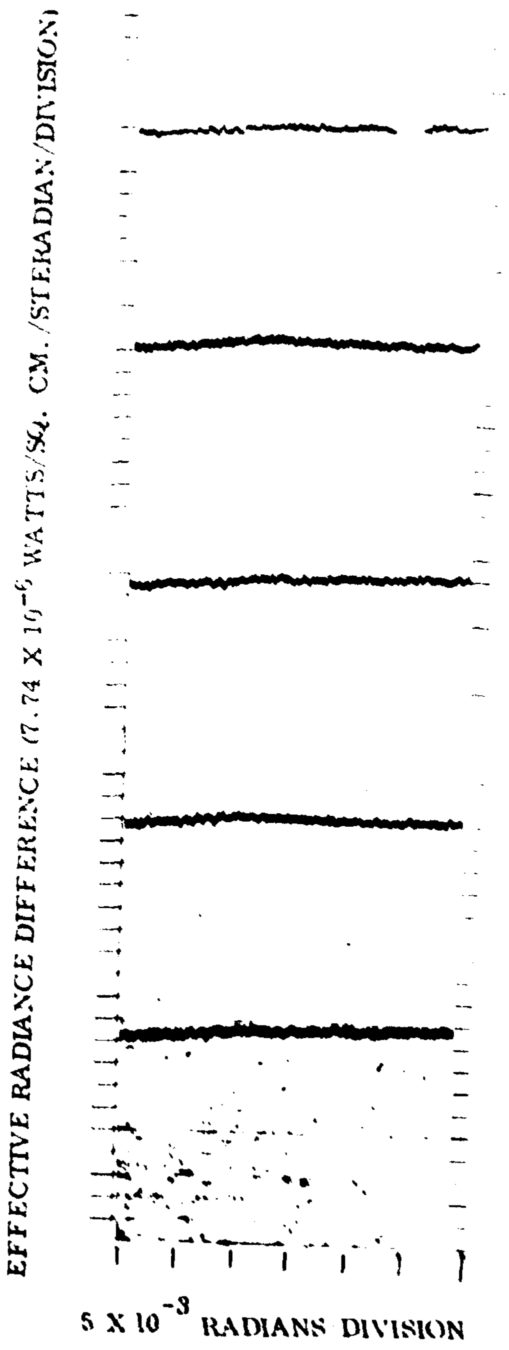
DATE: 8 MAY 1979
TIME: 10:30
TEMPERATURE: 82°F
RELATIVE HUMIDITY: 69%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 85°
TARGET ELEVATION: 19.0°
SUN TO TARGET ASPECT ANGLE: 40°

TARGET 41

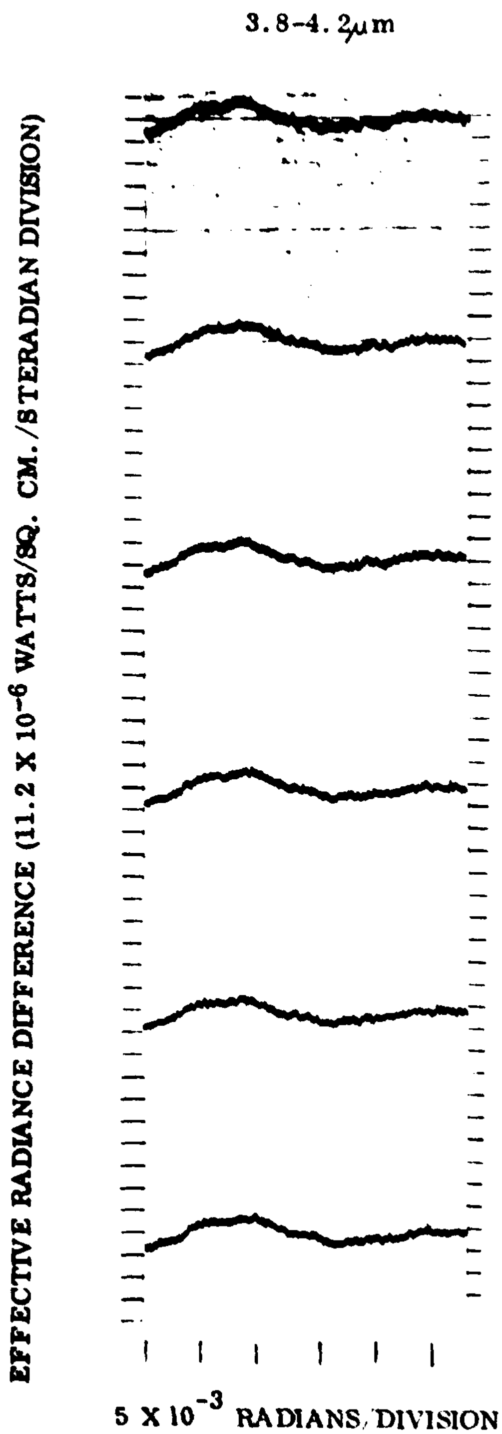
3.2-4.77μm

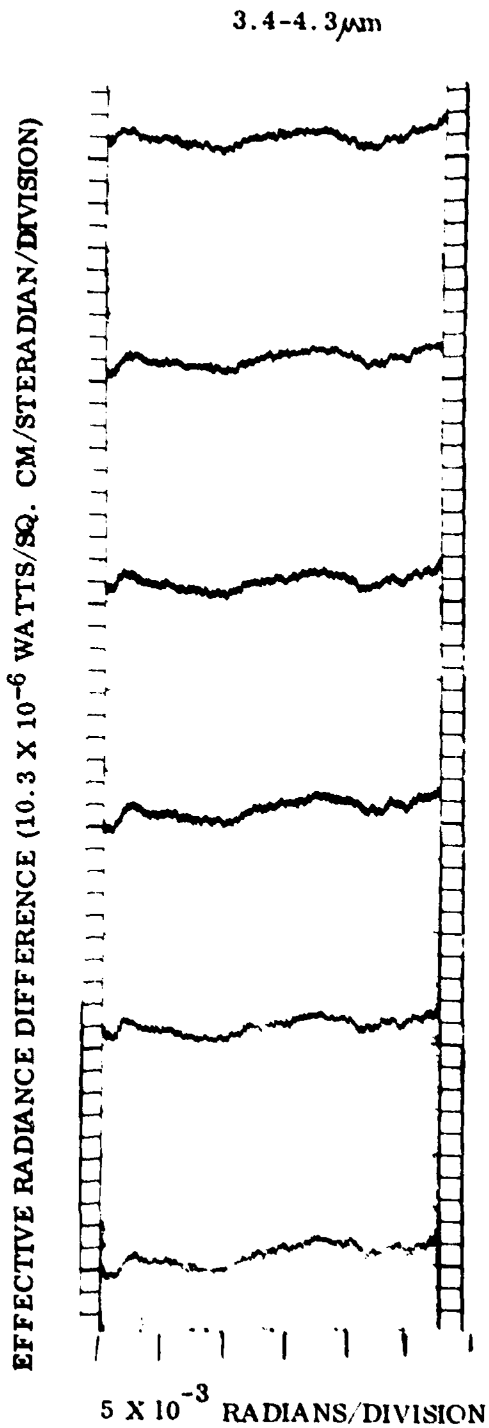


4.4-4.77μm



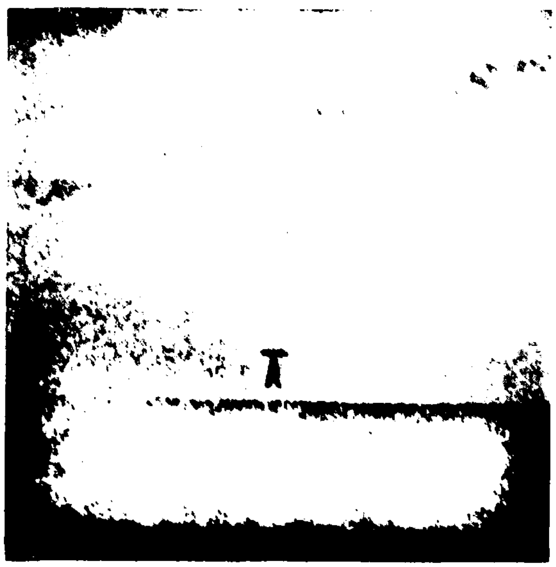
TARGET 41


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

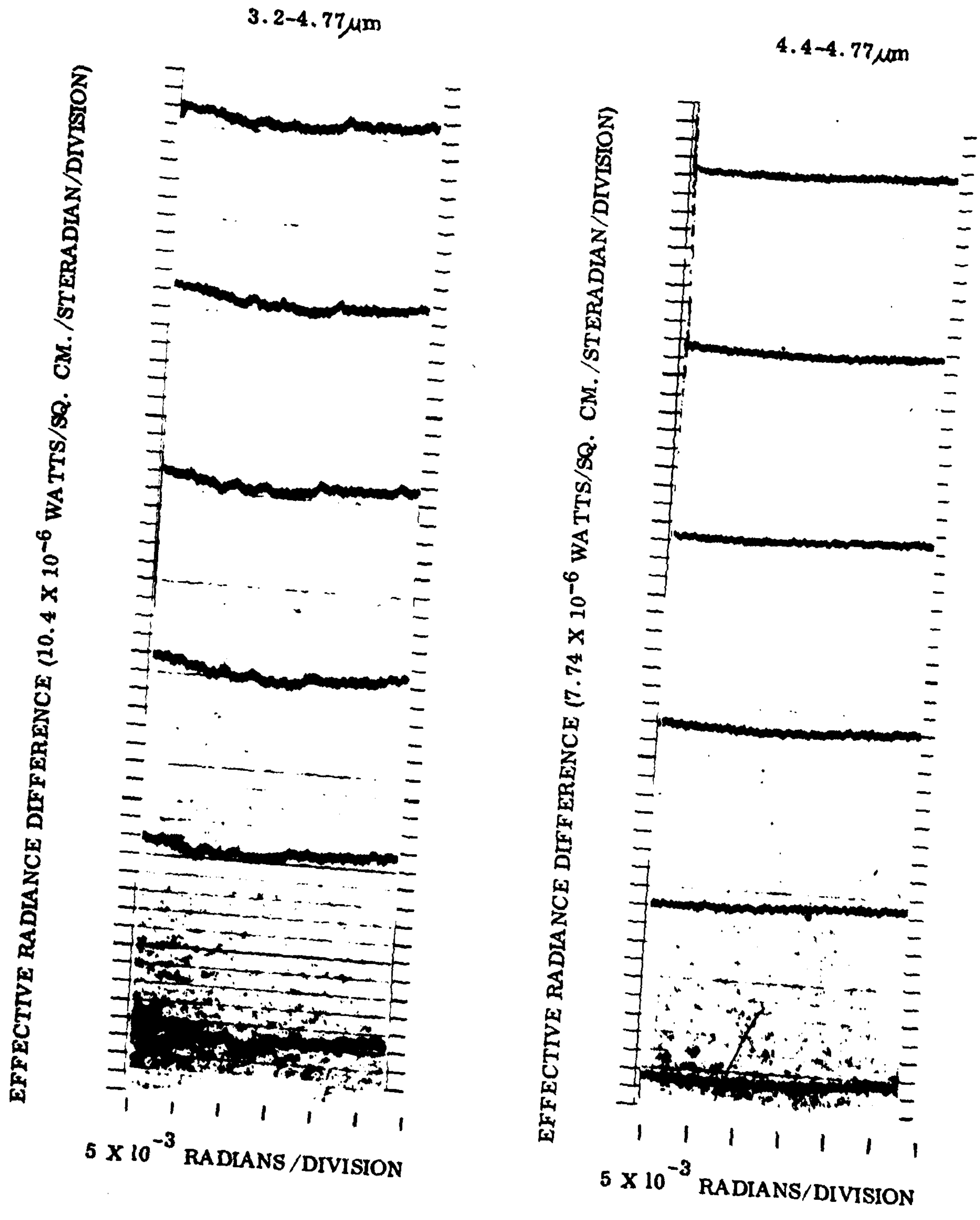

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 42

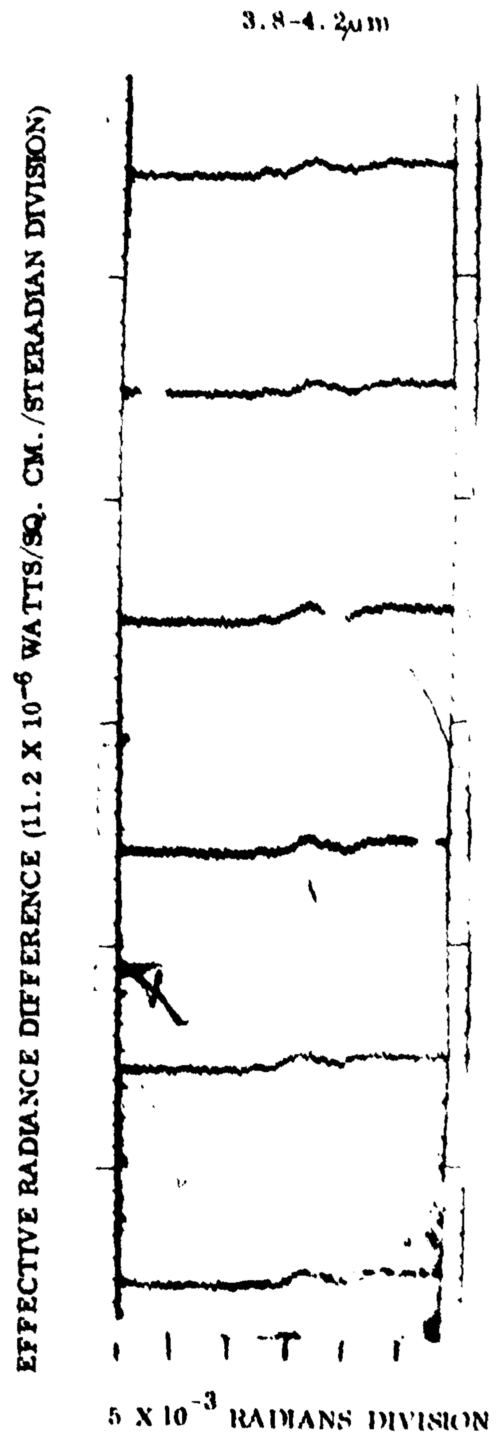
DATE: 8 MAY 1979
TIME: 10:35
TEMPERATURE: 82°F
RELATIVE HUMIDITY: 69%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 66°
TARGET ELEVATION: 2.1°
SUN TO TARGET ASPECT ANGLE: 87°
CORRELATED WITH IRST CLUTTER

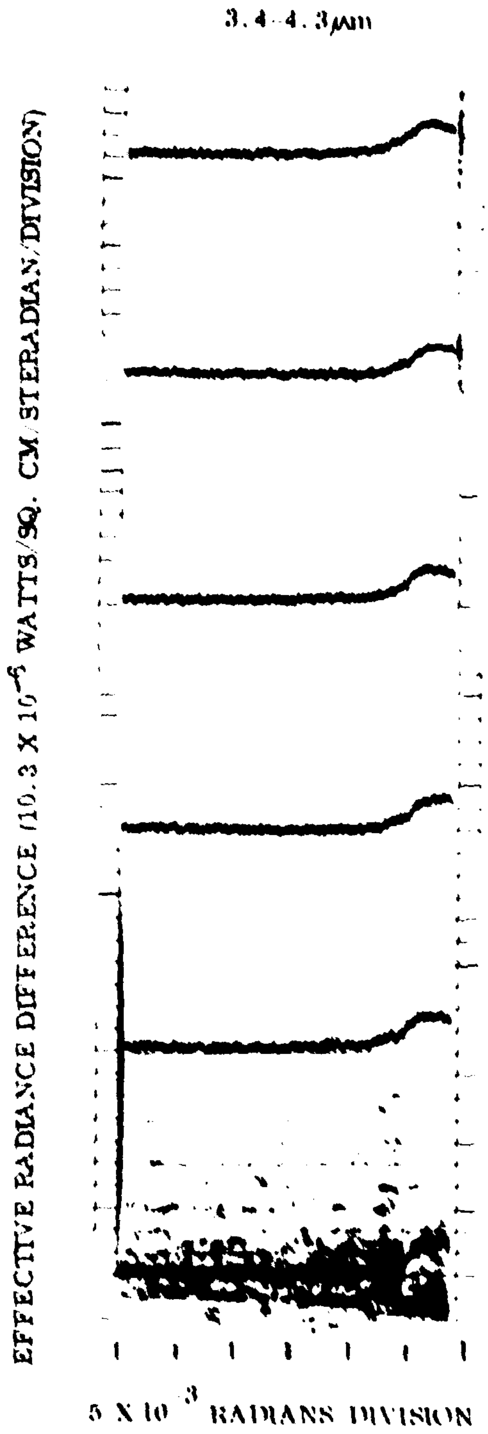


TARGET 42


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10⁻⁶ WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10⁻³ RADIANS/DIVISION
4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10⁻⁶ WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10⁻³ RADIANS/DIVISION

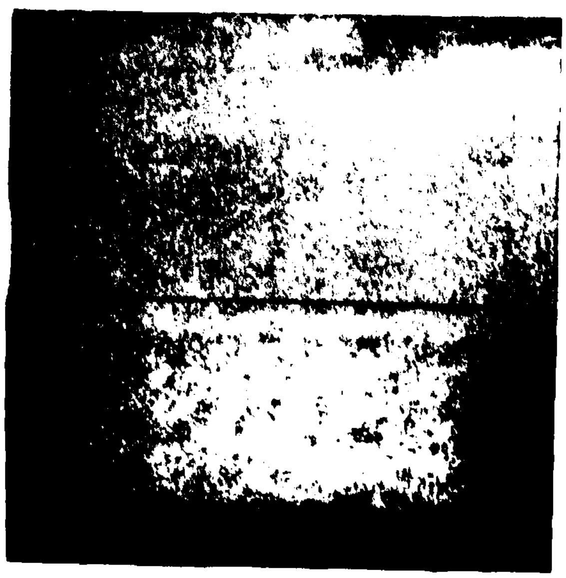
TARGET 42


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS DIVISION

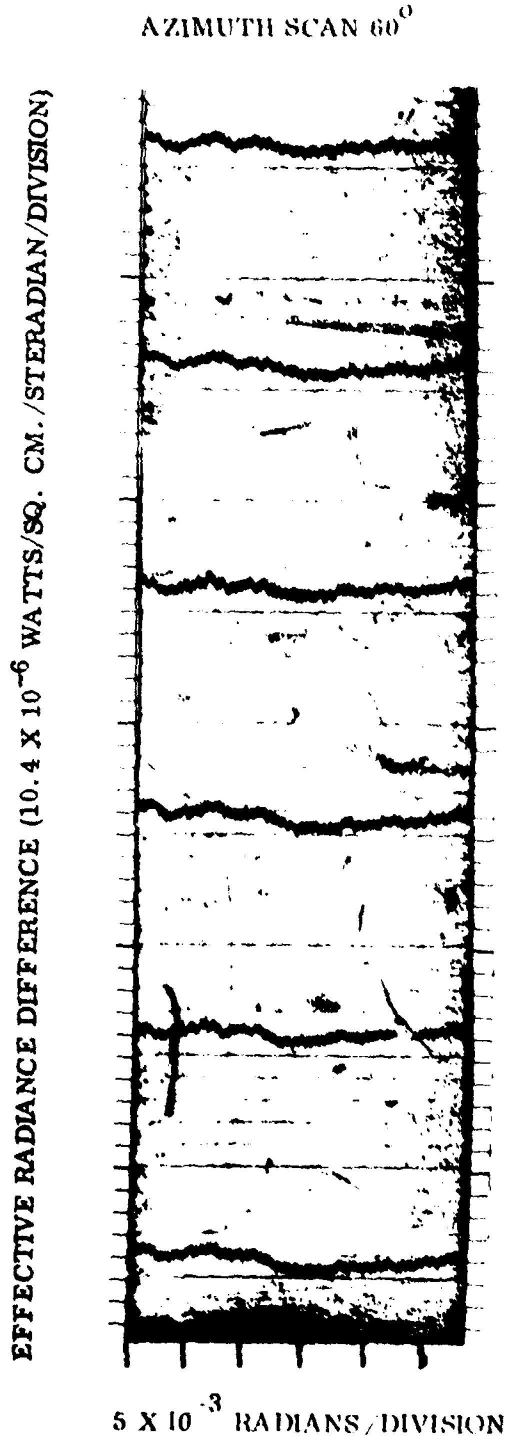

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION

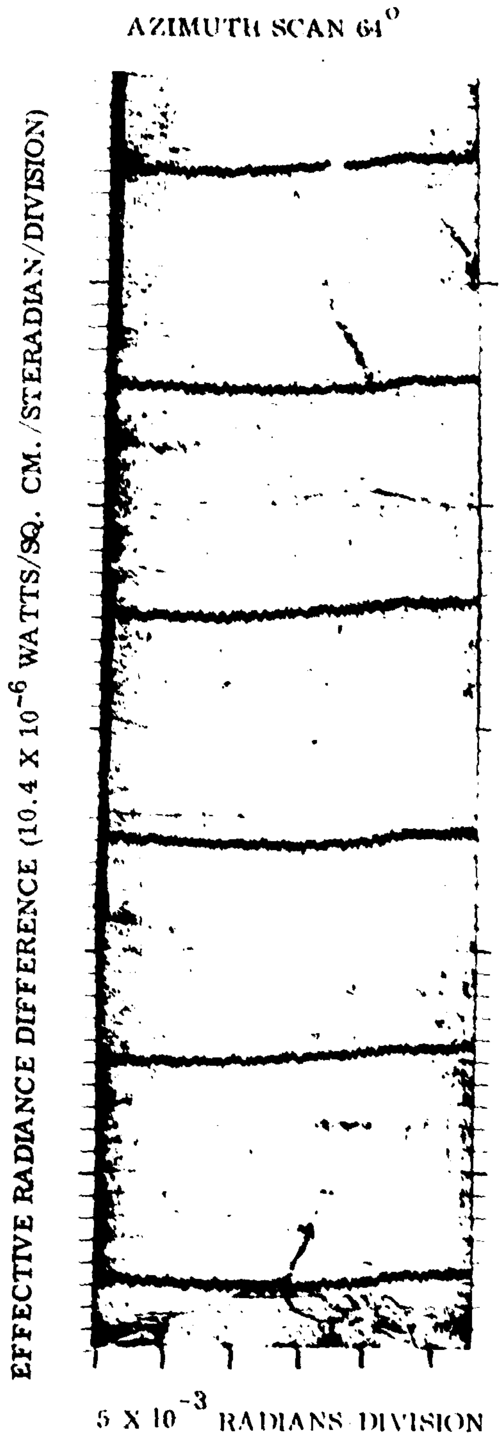
TARGET 43

DATE: 8 MAY 1979
TIME: 10:50
TEMPERATURE: 82^{o}F
RELATIVE HUMIDITY: 66%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 58^{o} to 80^{o}
TARGET ELEVATION: 2.6^{o}
CORRELATED WITH IRST CLUTTER
WIDE AZIMUTH SCAN

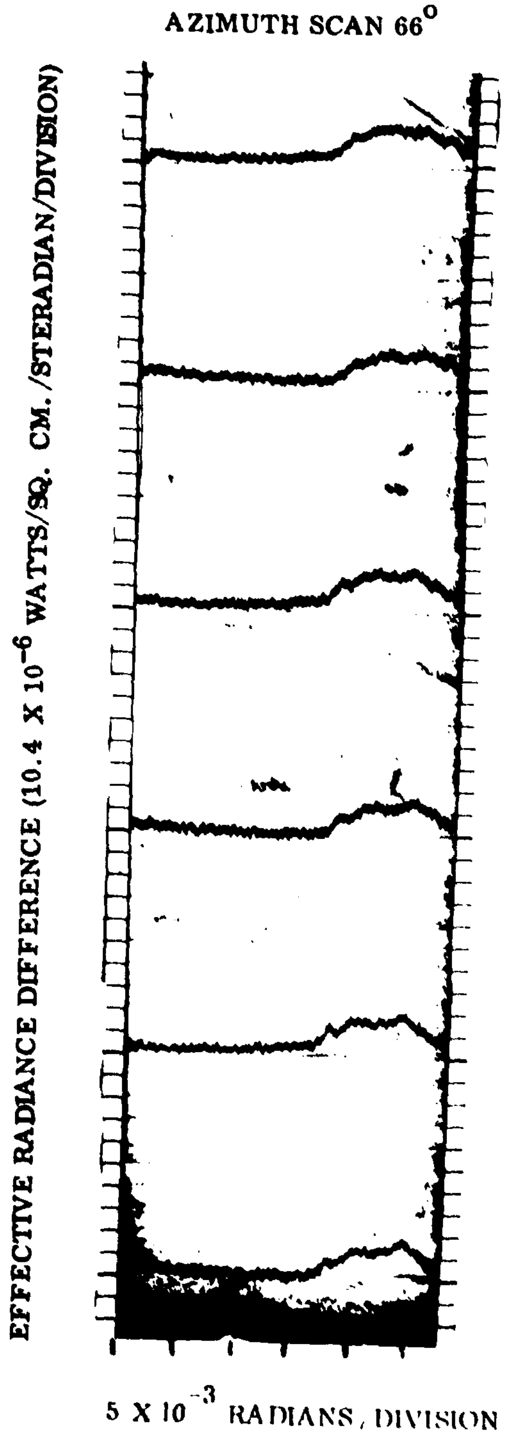


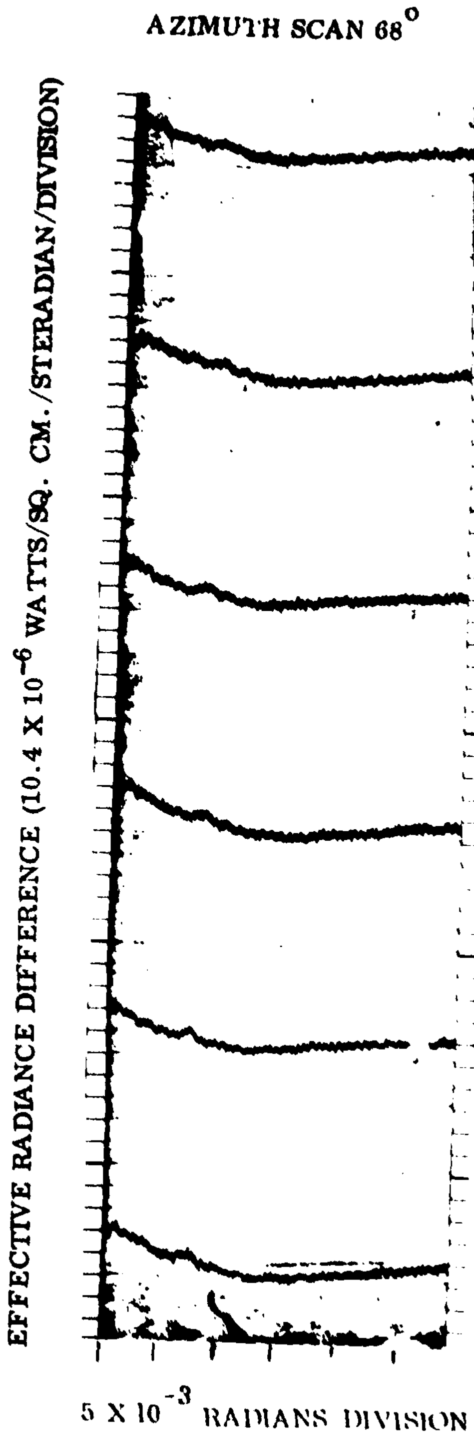
TARGET 43
3.2-4.77 μm





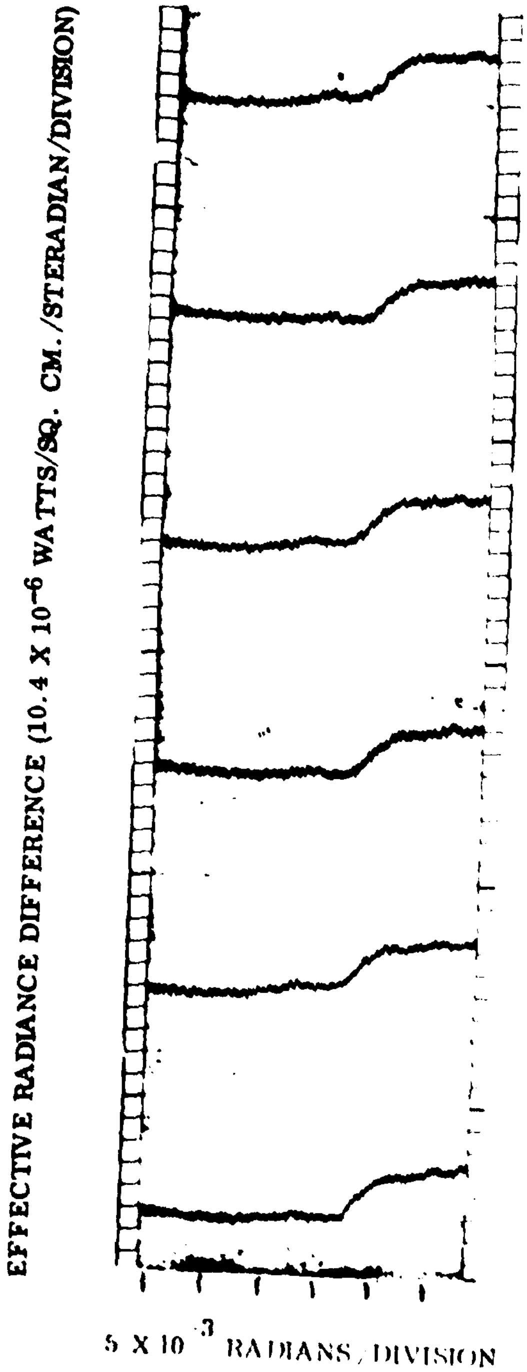
TARGET 43
3.2-4.77μm



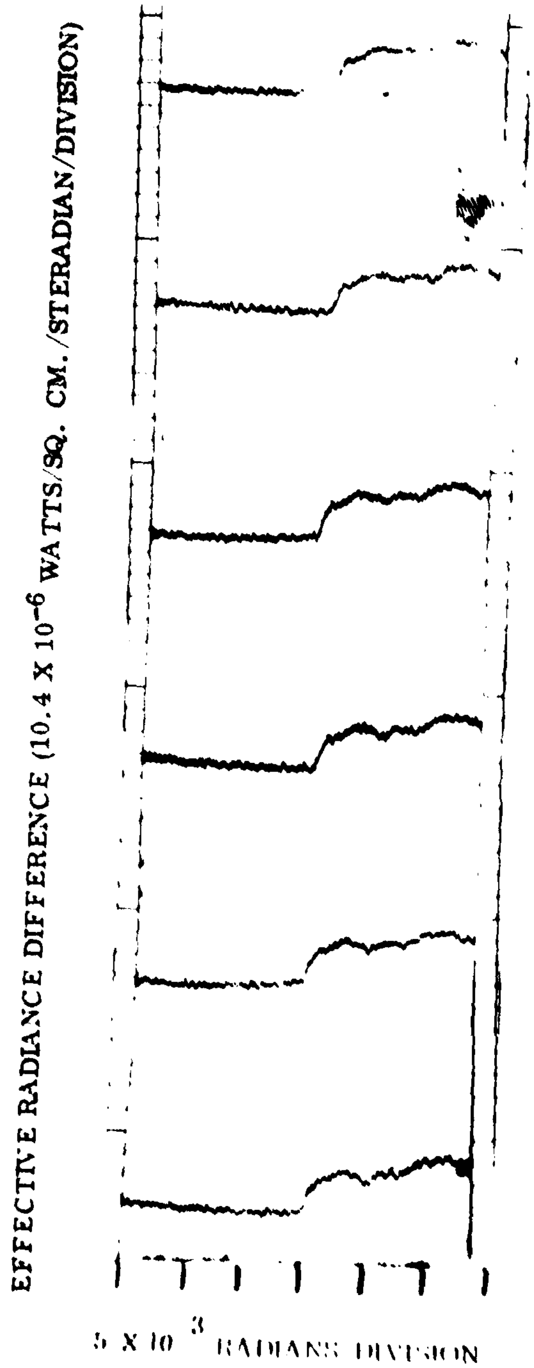


TARGET 43
3.2-4.77μm

AZIMUTH SCAN 70°

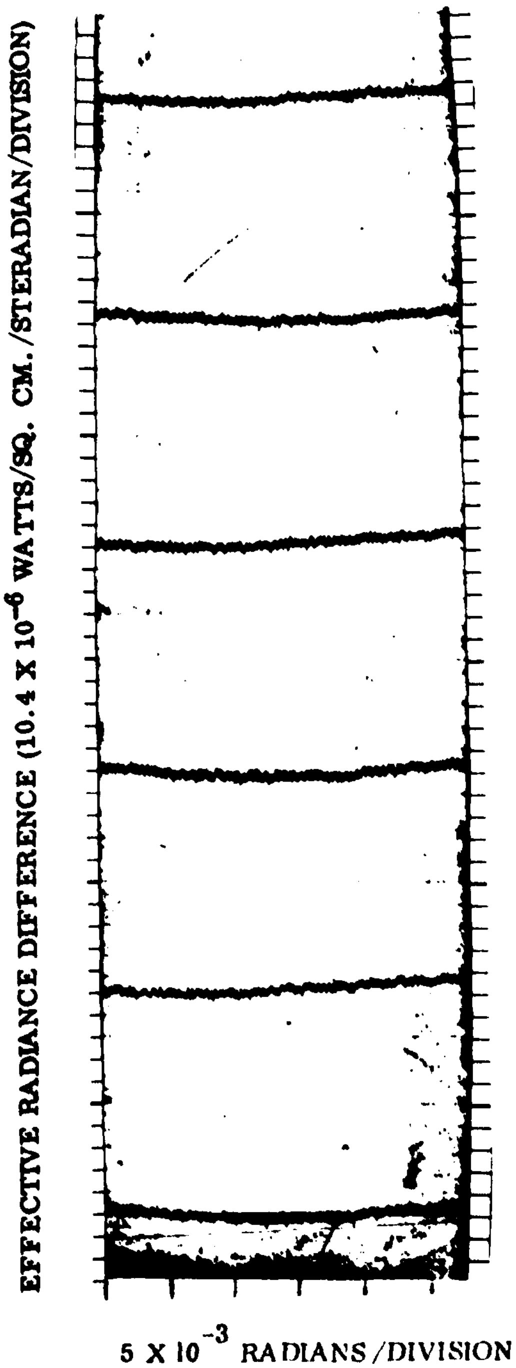


AZIMUTH SCAN 72°

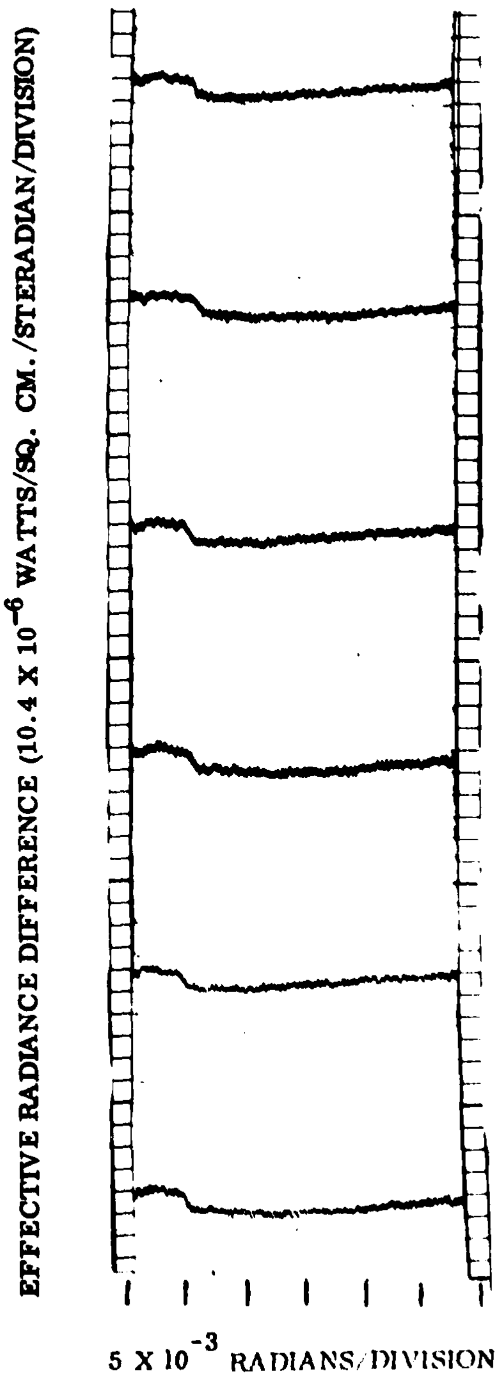


TARGET 43
3.2-4.77μm

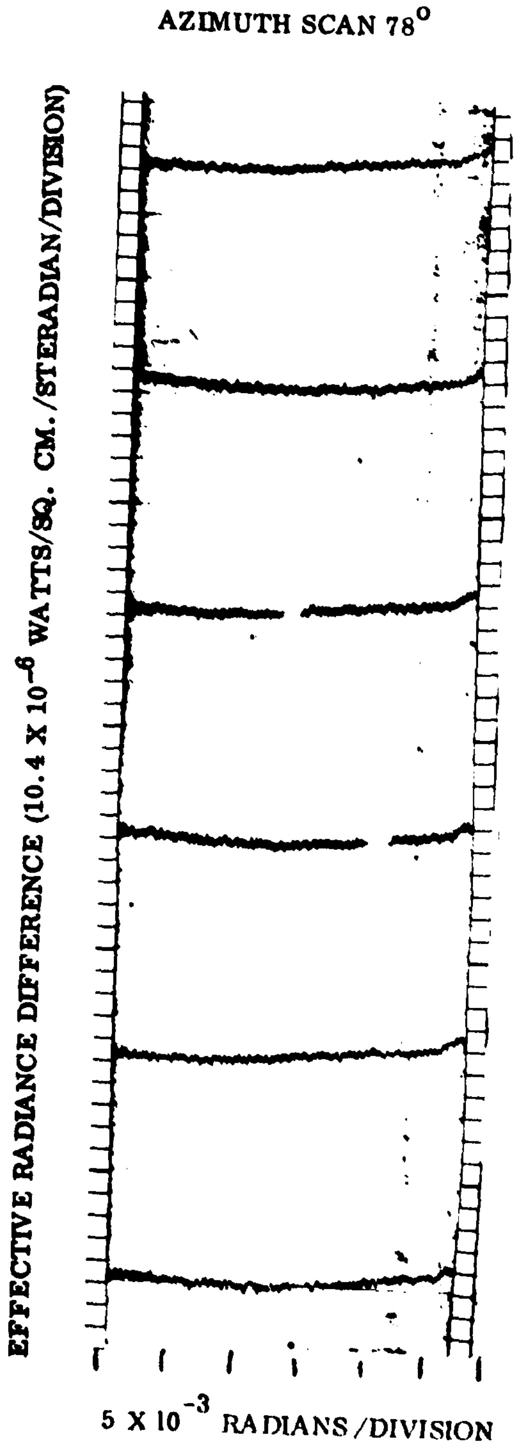
AZIMUTH SCAN 74°

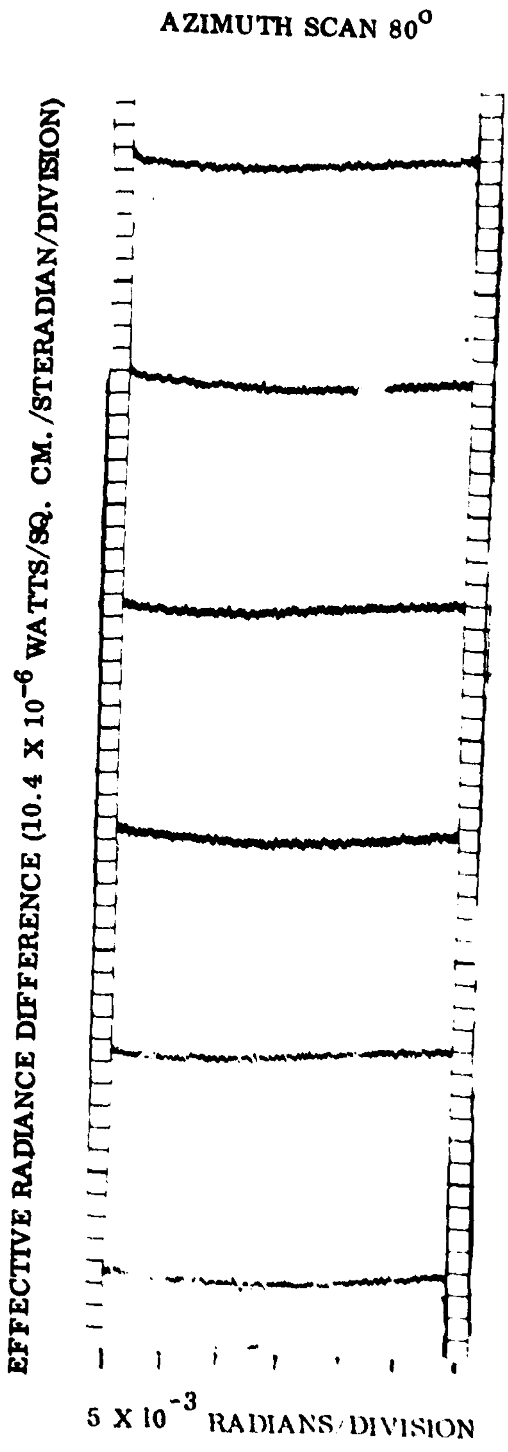


AZIMUTH SCAN 76°



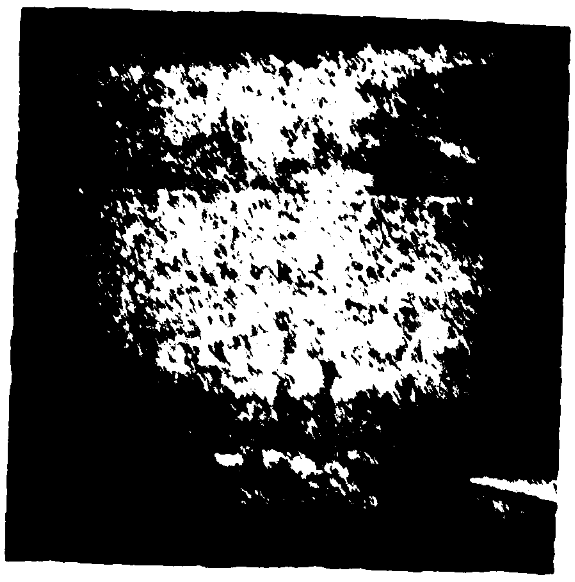
TARGET 43
3.2-4.77μm



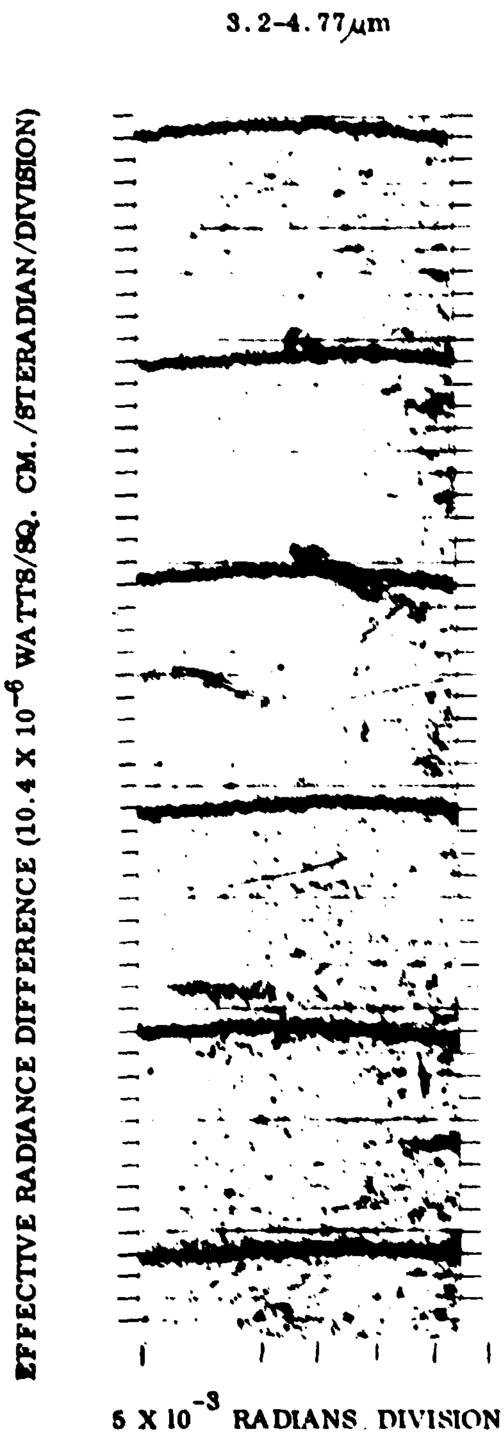


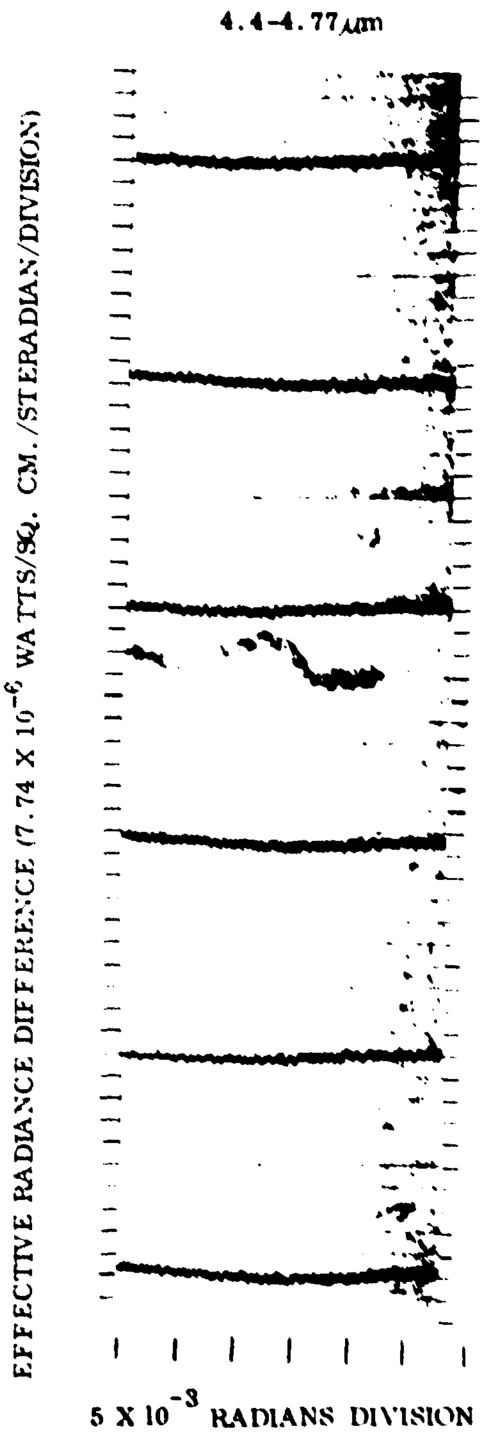
TARGET 45

DATE: 8 MAY 1979
TIME: 13:30
TEMPERATURE: 83°F
RELATIVE HUMIDITY: 64%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET ANGLE: 283°
TARGET ELEVATION: 0°
SUN TO TARGET ASPECT ANGLE: 87°
SCAN ACROSS HORIZON

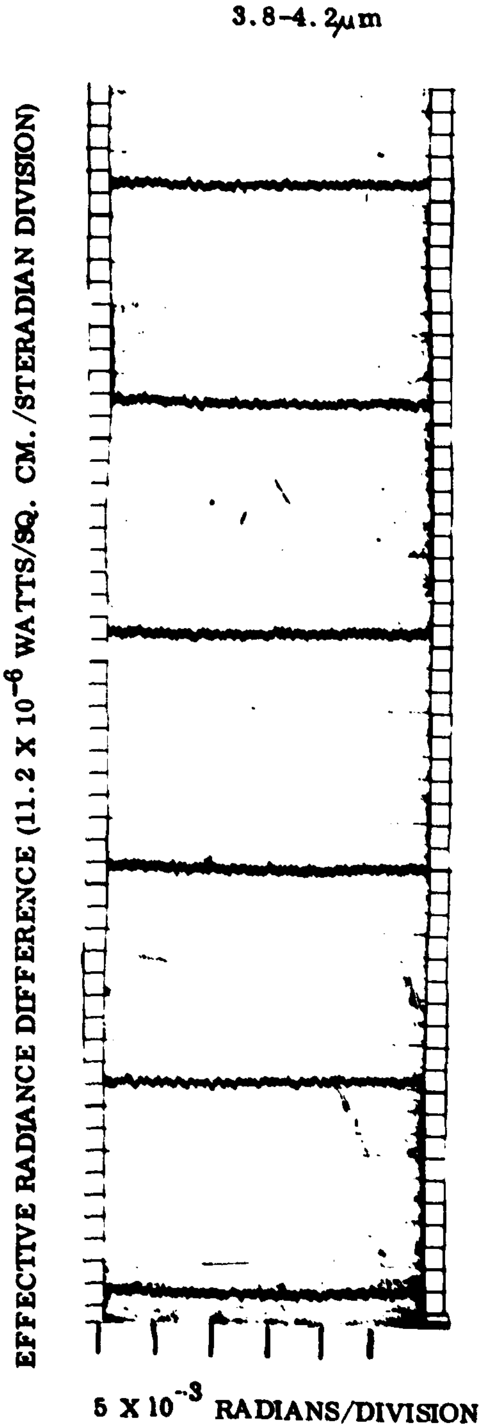


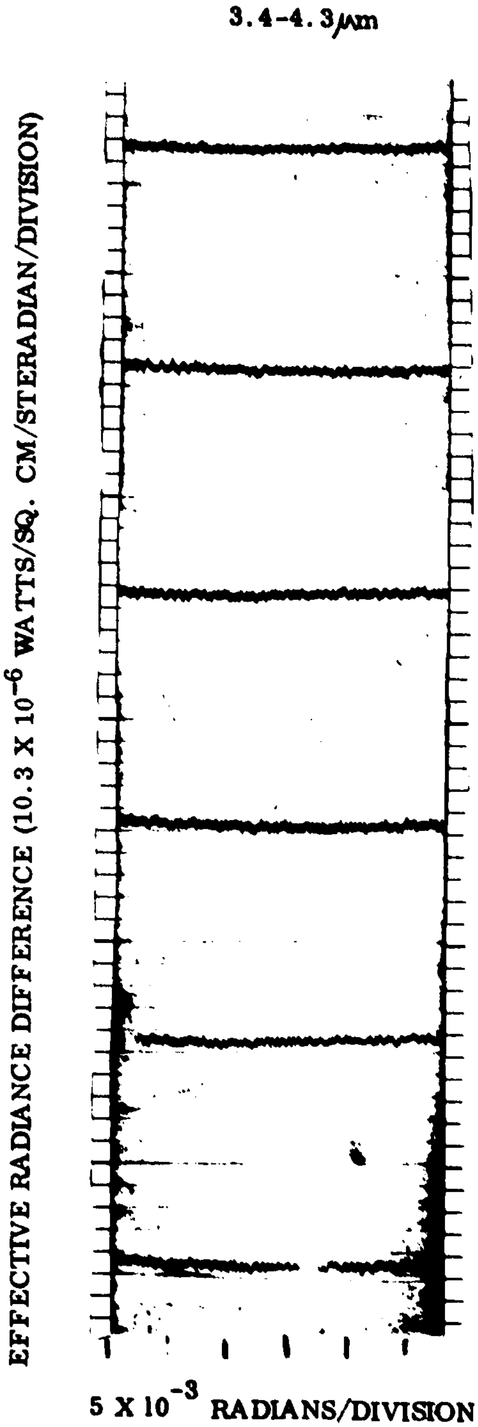
TARGET 45


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION


4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION

TARGET 45

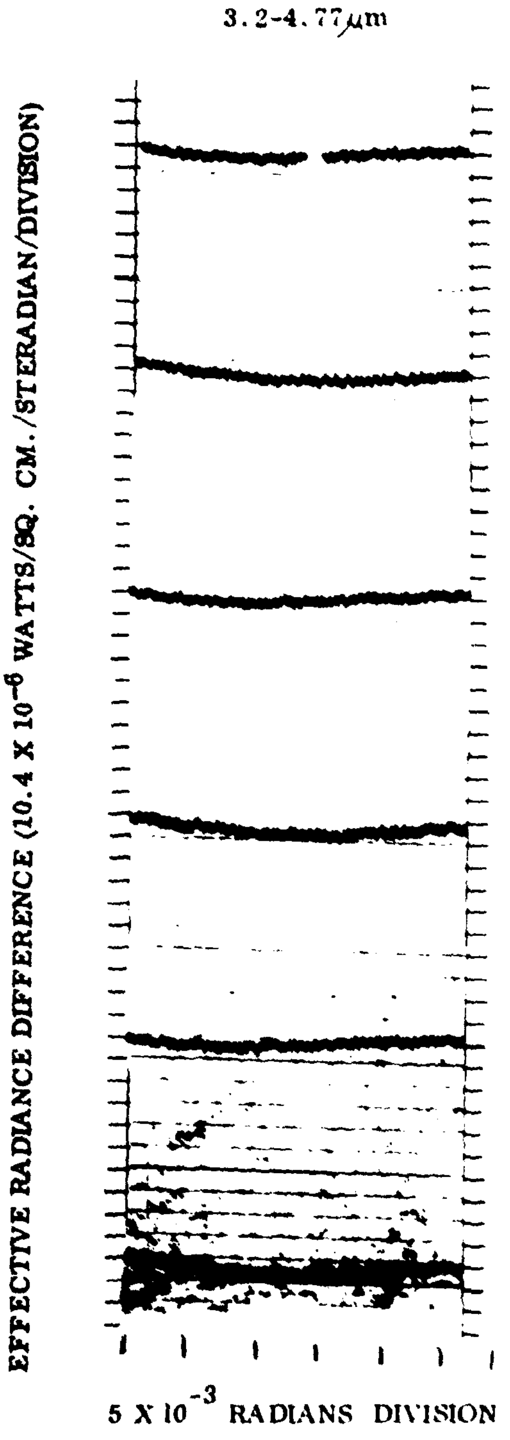

3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

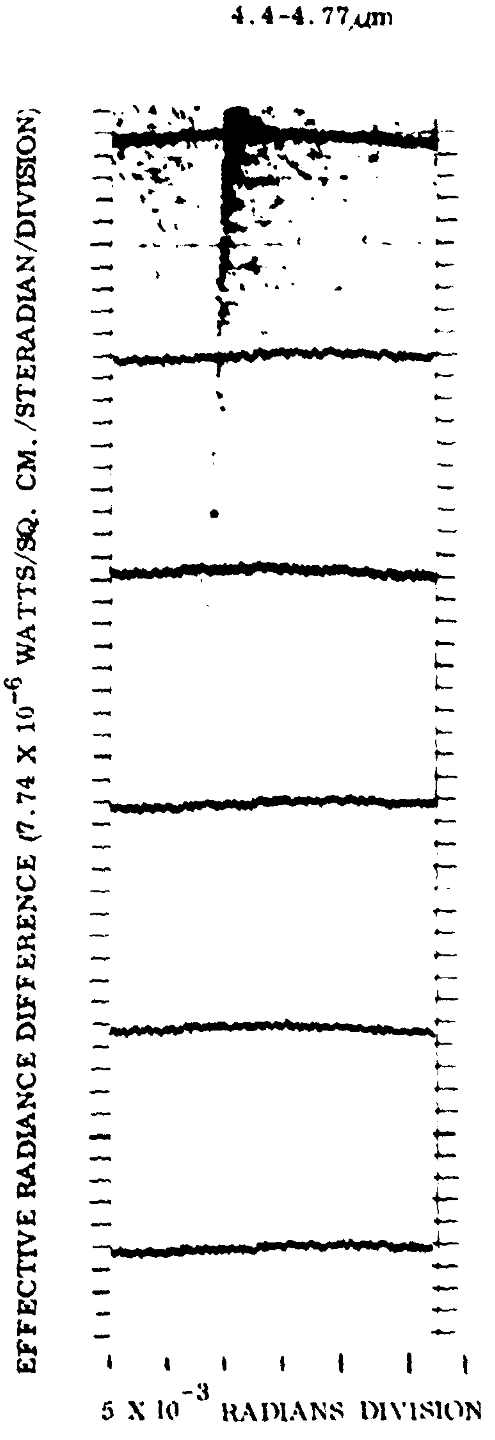

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 46

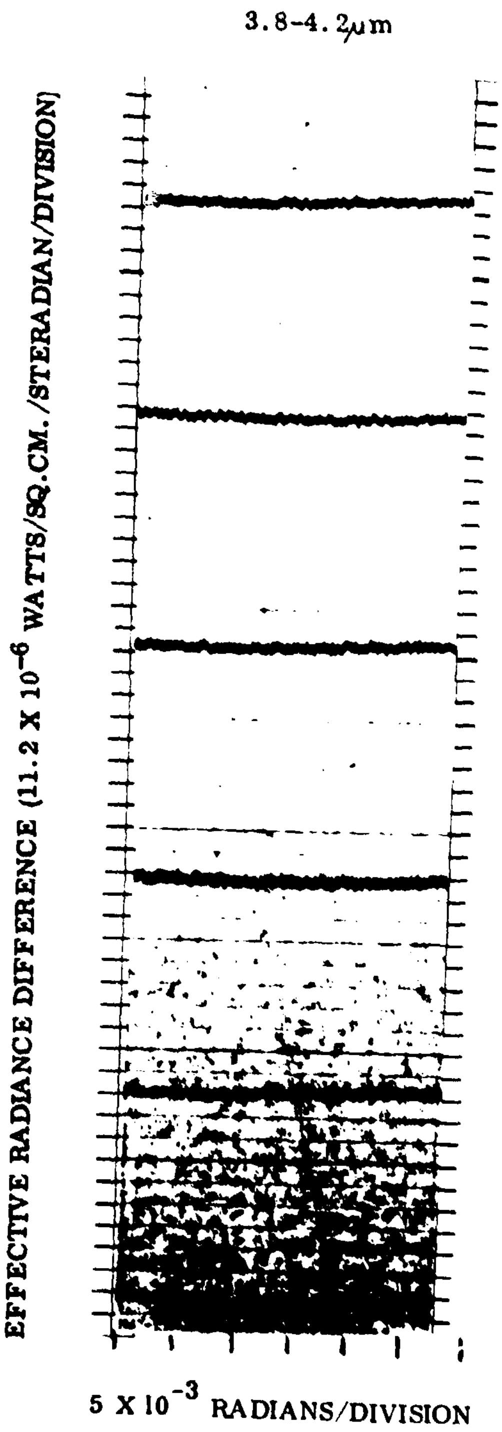
DATE: 8 MAY 1979
TIME: 13:32
TEMPERATURE: 83°F
RELATIVE HUMIDITY: 64%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 283°
TARGET ELEVATION: 1.0°
SUN TO TARGET ASPECT ANGLE: 85°
SCAN JUST ABOVE HORIZON

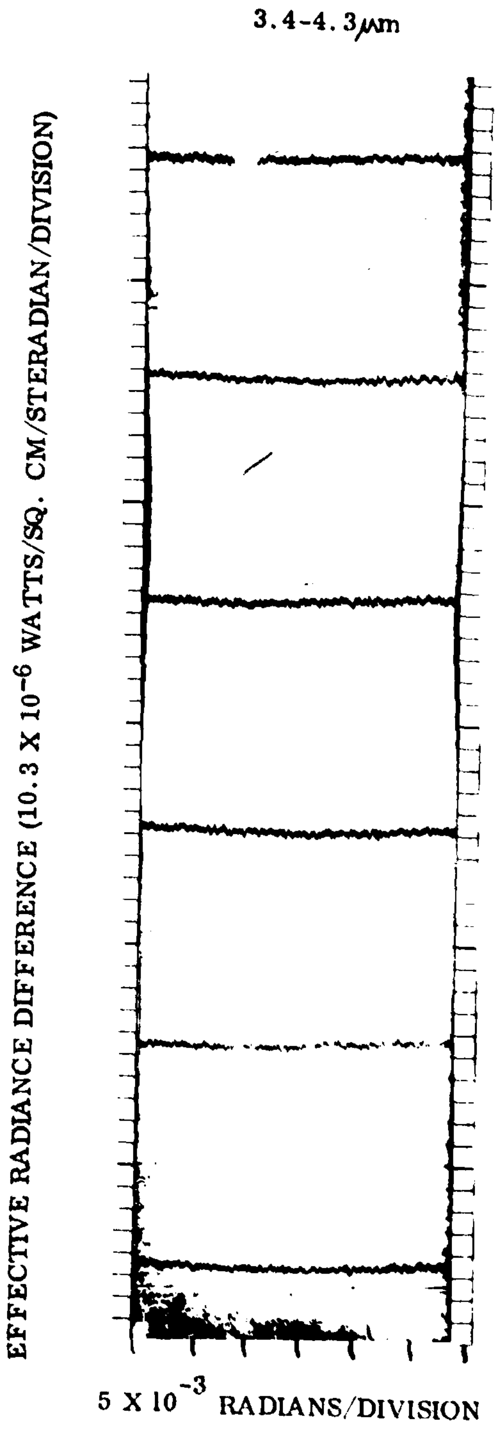
TARGET 46


3.2-4.77 μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^{-6} WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^{-3} RADIANS DIVISION


4.4-4.77 μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^{-6} WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^{-3} RADIANS DIVISION

TARGET 46

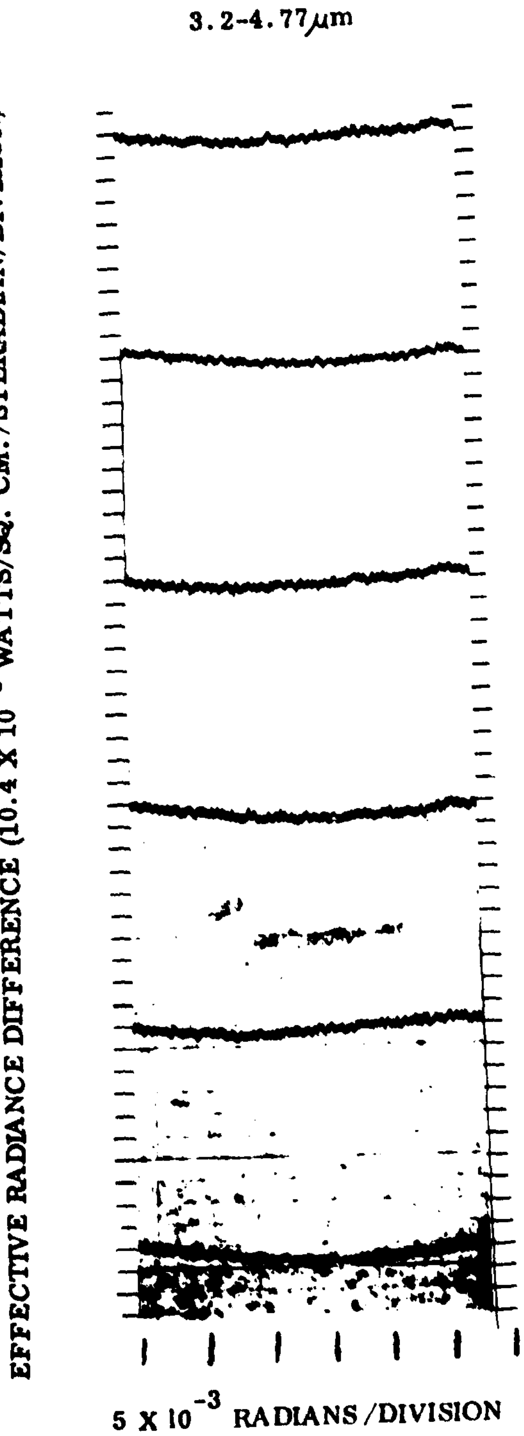

3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ.CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

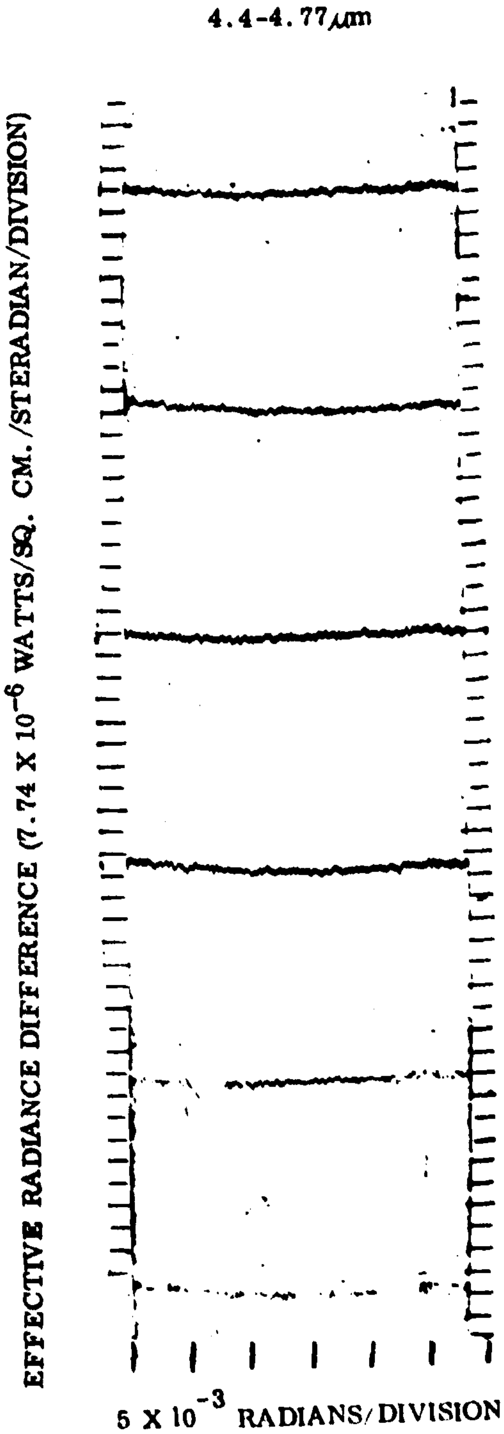

3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 47

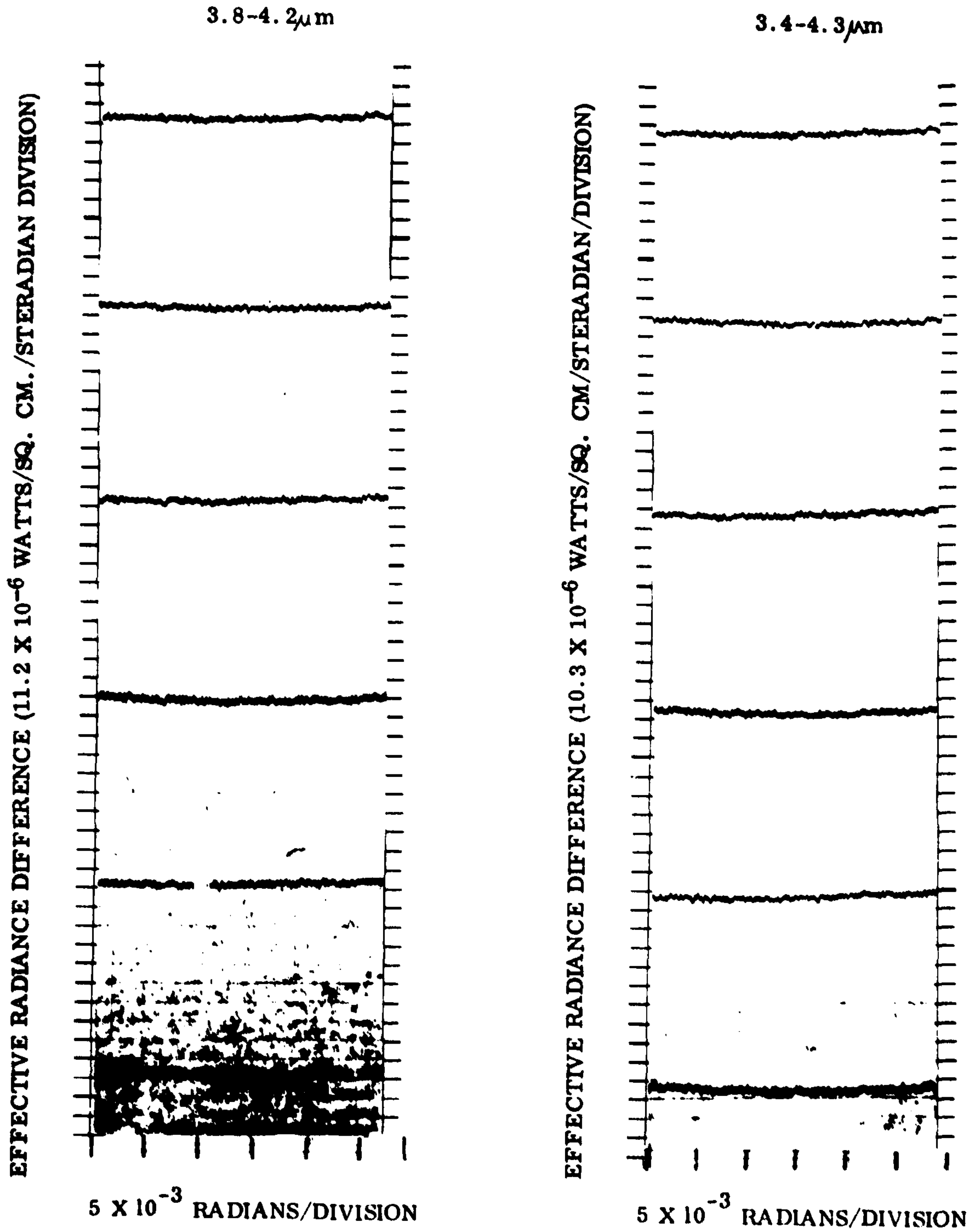
DATE: 8 MAY 1979
TIME: 13:34
TEMPERATURE: 84°F
RELATIVE HUMIDITY: 63%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30%
TARGET AZ ANGLE: 283°
TARGET ELEVATION: -1.0°
SUN TO TARGET ASPECT ANGLE: 87°
SCAN JUST BELOW HORIZON

TARGET 47


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION


4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

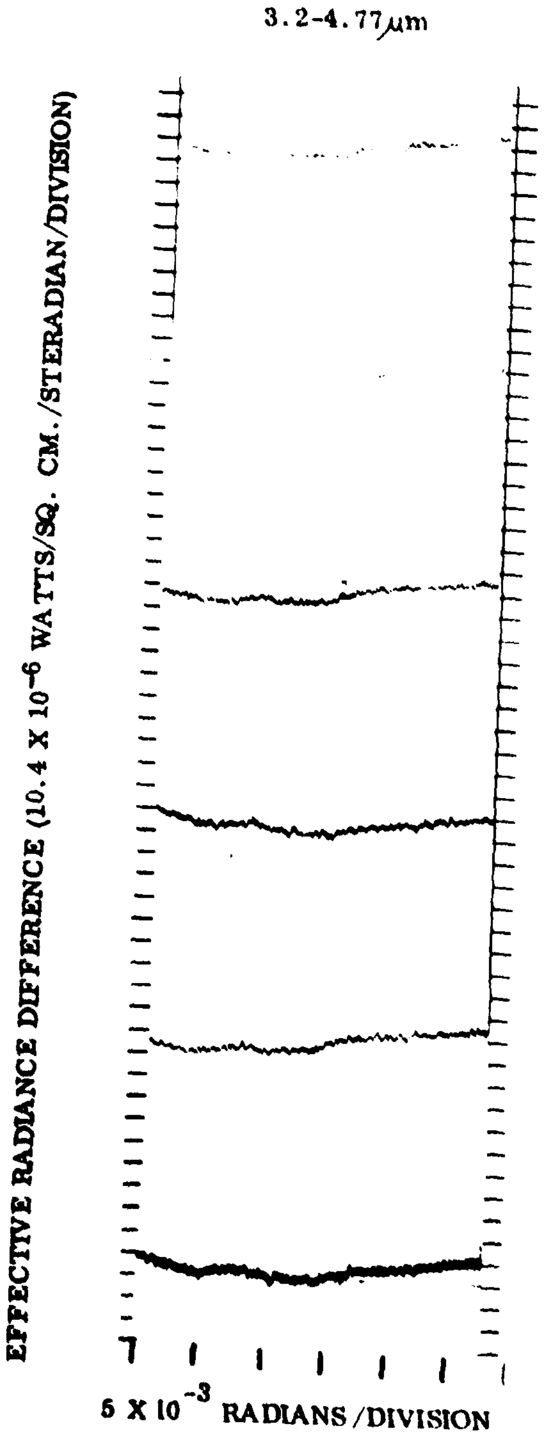
TARGET 47

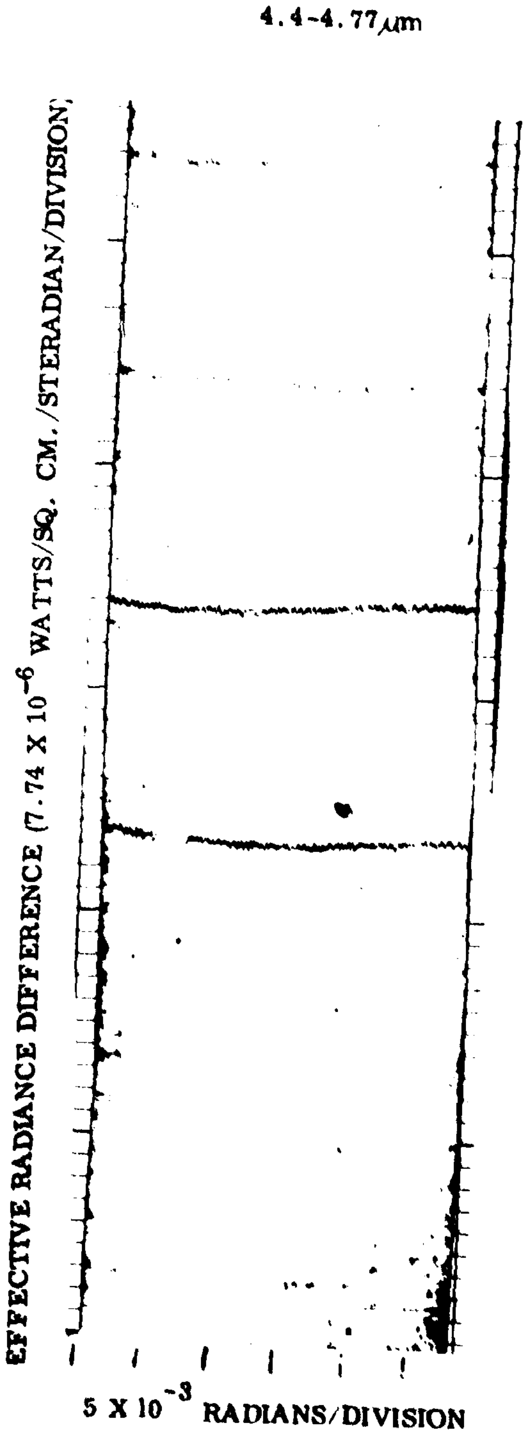

3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^{-6} WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^{-3} RADIANS/DIVISION
3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^{-6} WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^{-3} RADIANS/DIVISION

TARGET 48

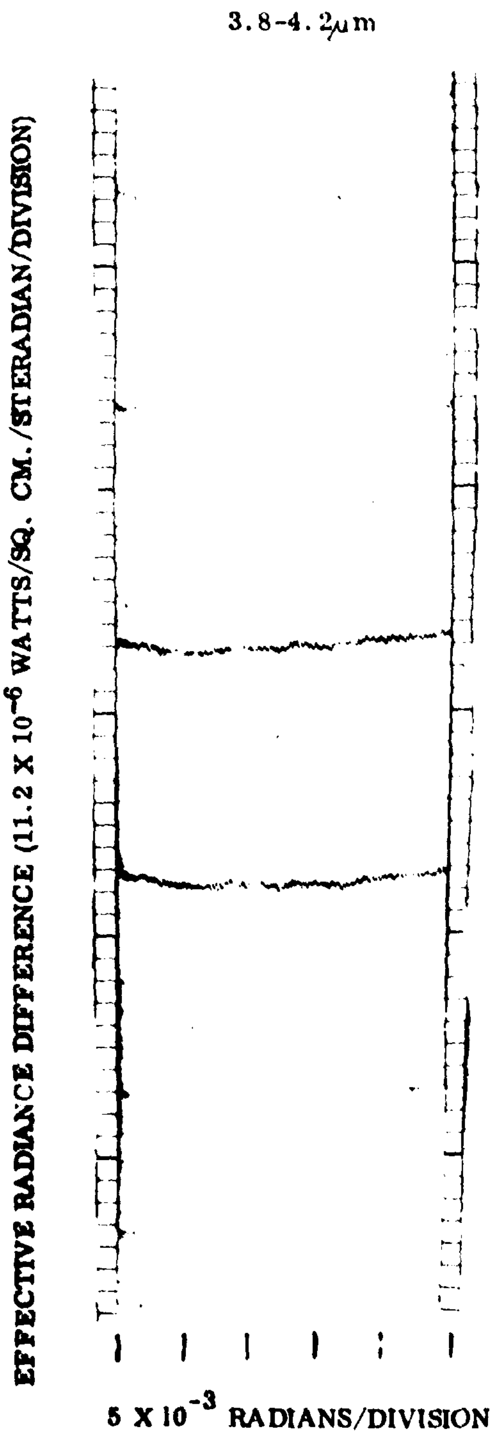
DATE: 8 MAY 1979
TIME: 16:50
TEMPERATURE: 84°F
RELATIVE HUMIDITY: 62%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 88°
TARGET ELEVATION: 16.2°
SUN TO TARGET ASPECT ANGLE: 122°

TARGET 48

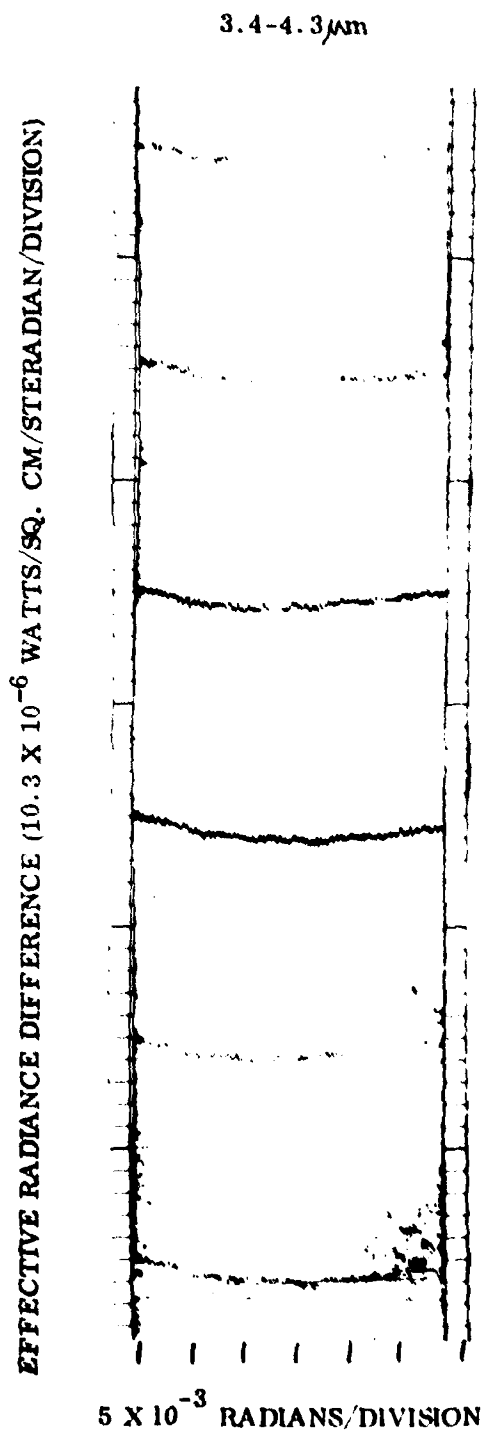

3.2-4.77µm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10⁻⁶ WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10⁻³ RADIANS/DIVISION


4.4-4.77µm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10⁻⁶ WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10⁻³ RADIANS/DIVISION

TARGET 48



3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION



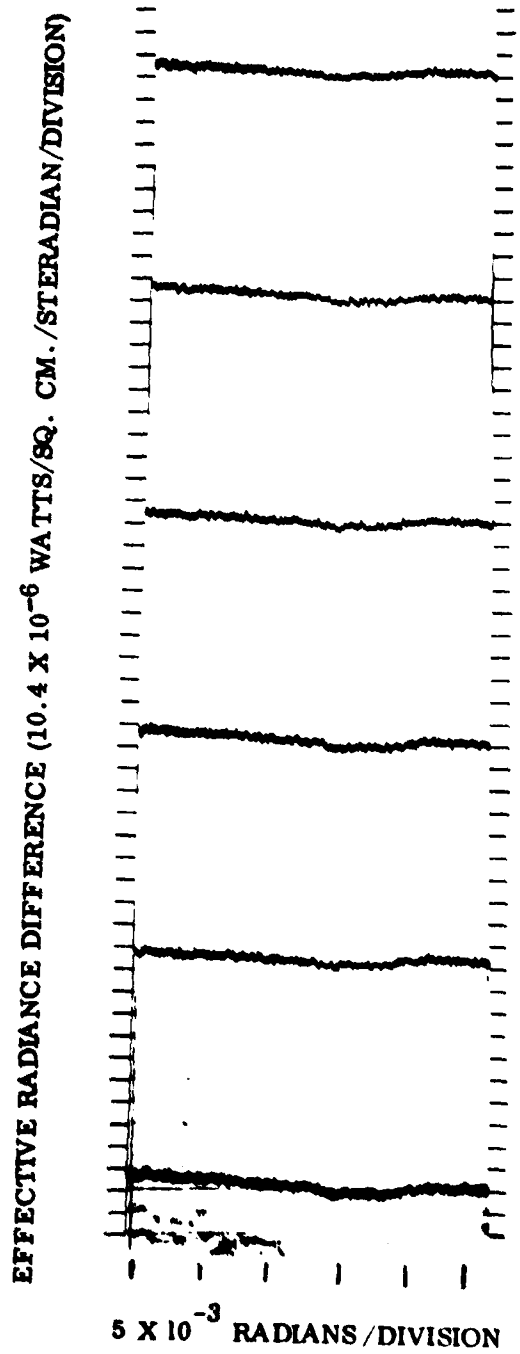
3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 49

DATE: 8 MAY 1979
TIME: 20:18
TEMPERATURE: 80°F
RELATIVE HUMIDITY: 79%
VISIBILITY: 3 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 123°
TARGET ELEVATION: 14.4°

TARGET 49

3.2-4.77μm



4.4-4.77μm

EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^{-6} WATTS/SQ. CM./STERADIAN/DIVISION)

DATA NOT AVAILABLE

5 X 10^{-3} RADIANS DIVISION

TARGET 49

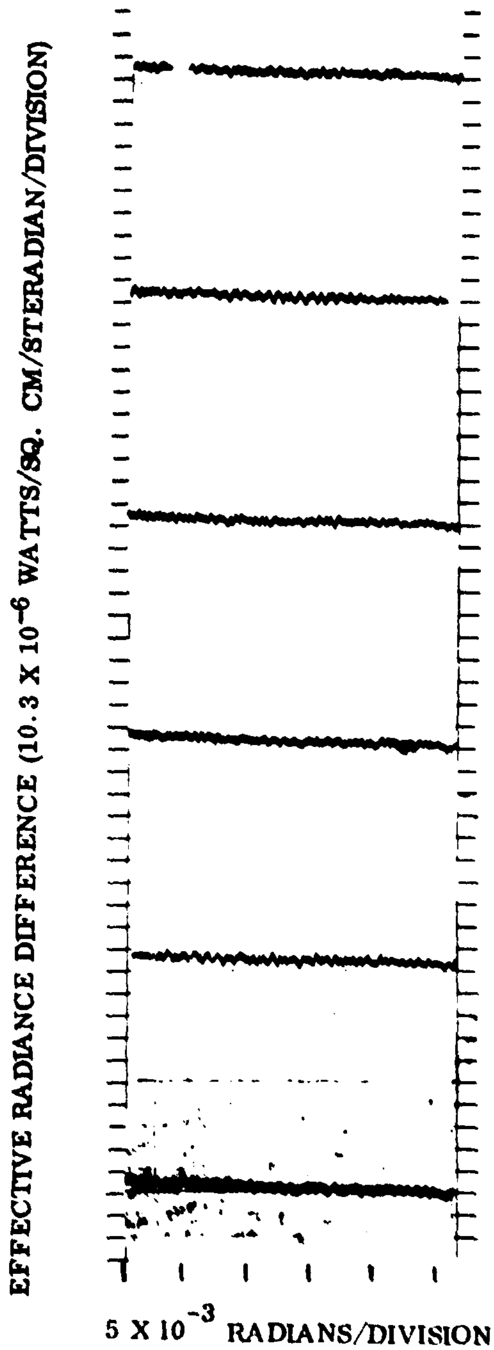
3.8-4.2μm

EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^{-6} WATTS/SQ. CM./STERADIAN DIVISION)

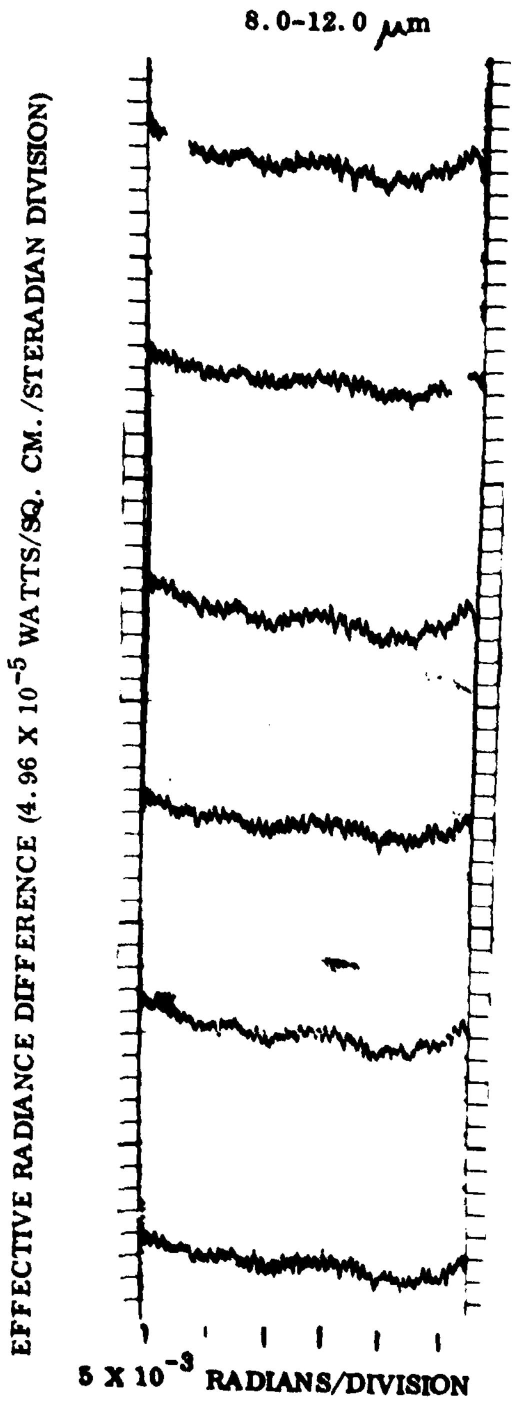
DATA NOT
AVAILABLE

5 X 10^{-3} RADIANS/DIVISION

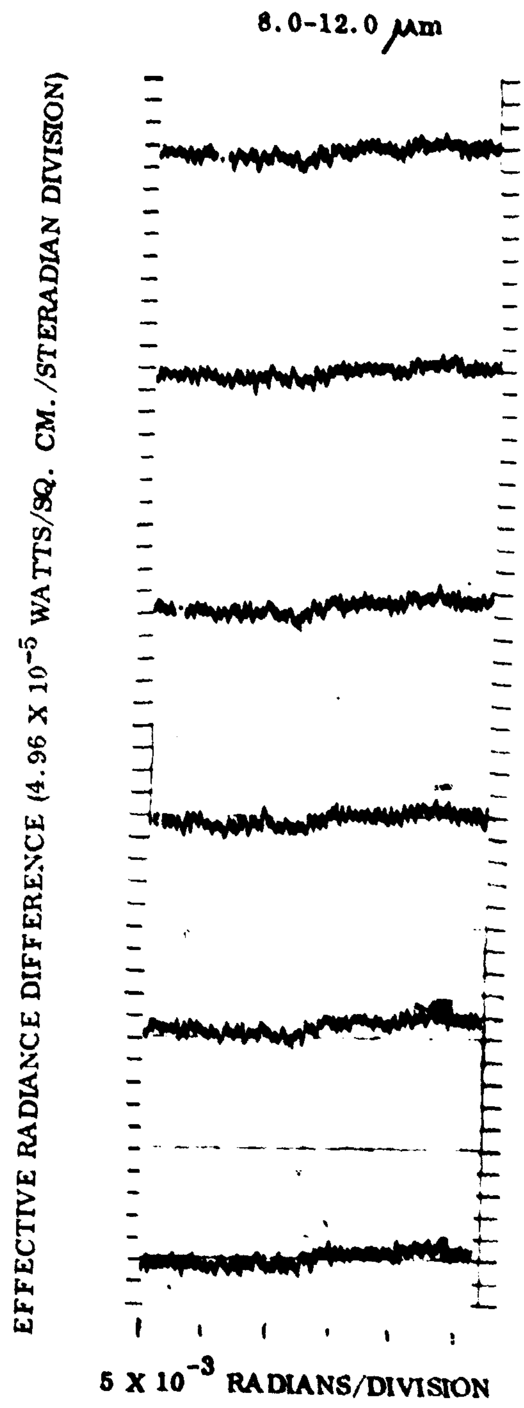
3.4-4.3μm



TARGET 49



8.0-12.0 μm
EFFECTIVE RADIANCE DIFFERENCE (4.96 X 10^-5 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION



8.0-12.0 μm
EFFECTIVE RADIANCE DIFFERENCE (4.96 X 10^-5 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

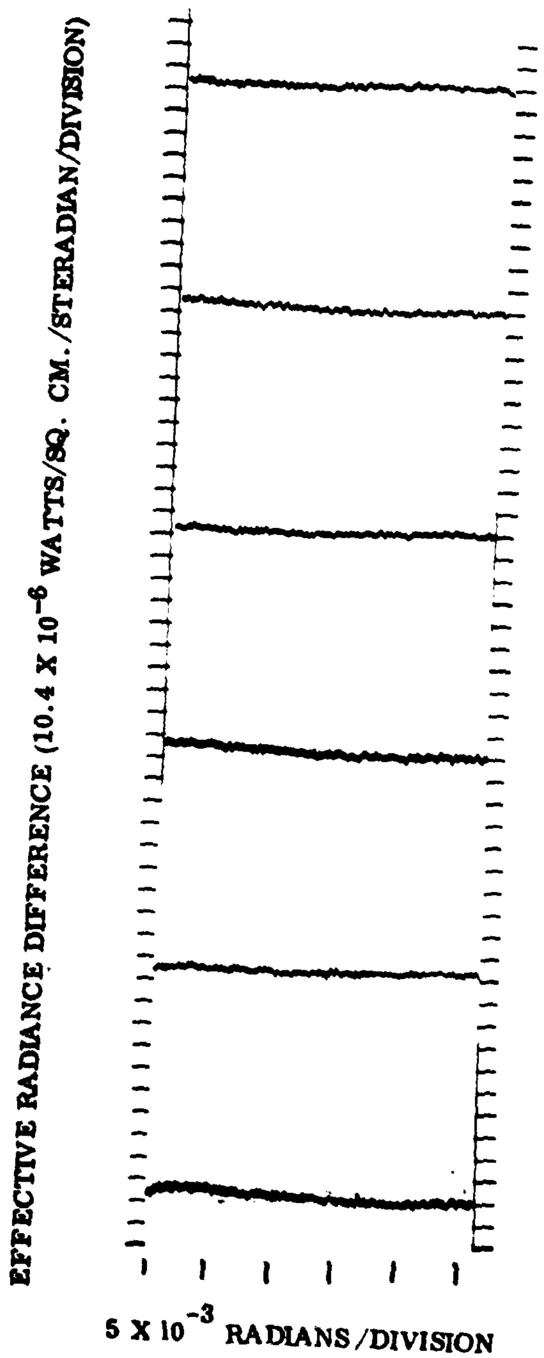
TARGET 51

DATE: 8 MAY 1979
TIME: 20:31
TEMPERATURE: 80°F
RELATIVE HUMIDITY: 79%
VISIBILITY: 3 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 68°
TARGET ELEVATION: 24°

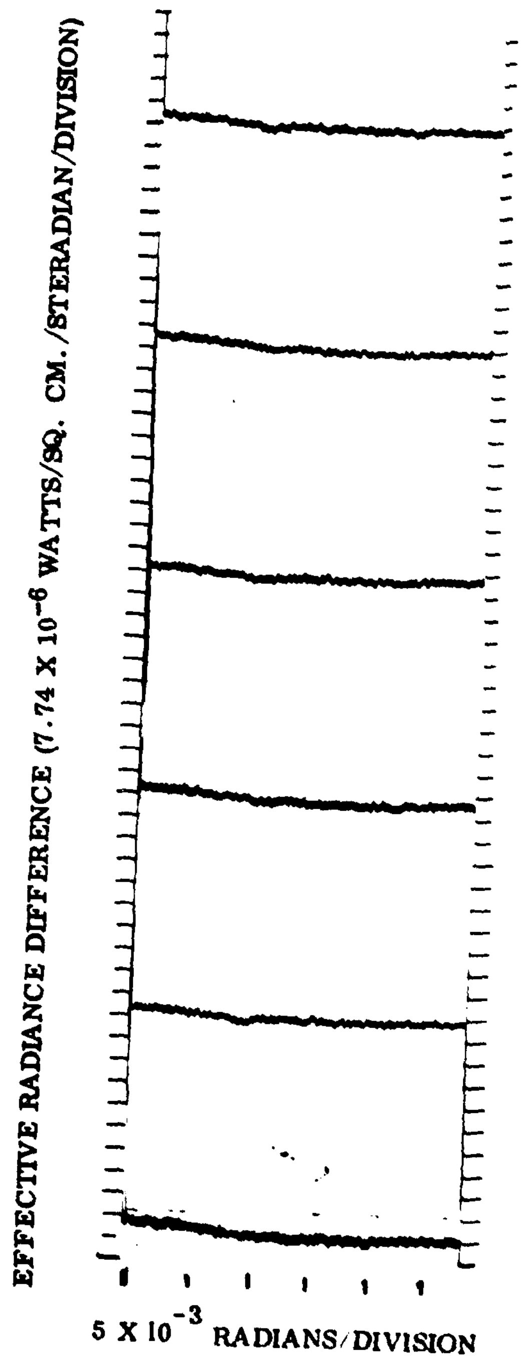
NO PHOTOGRAPH AVAILABLE

TARGET 51

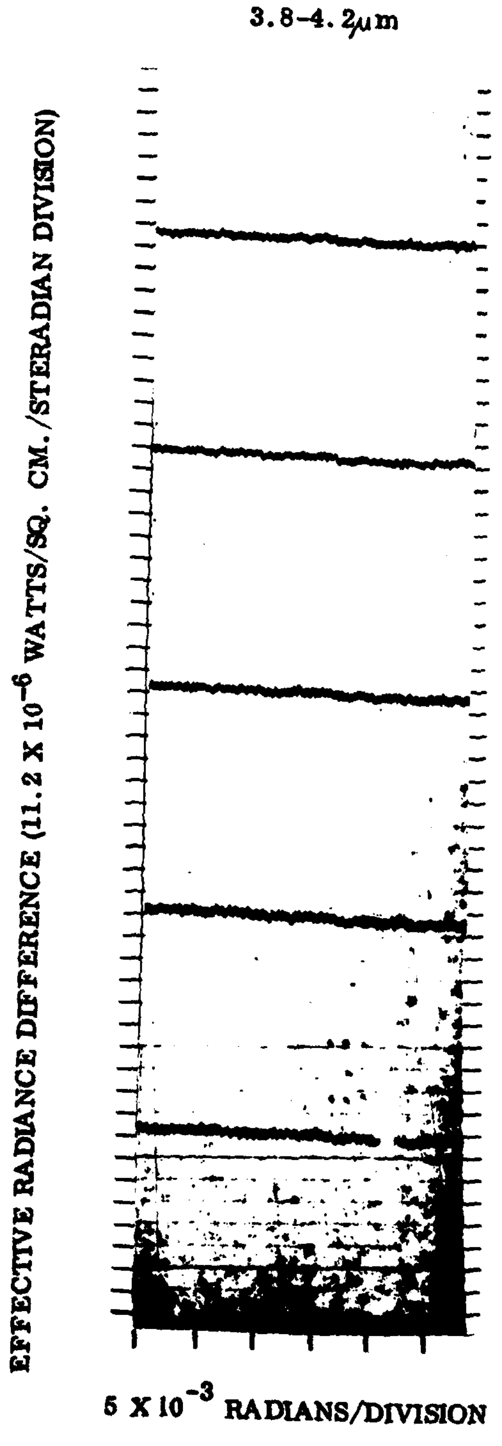
3.2-4.77μm



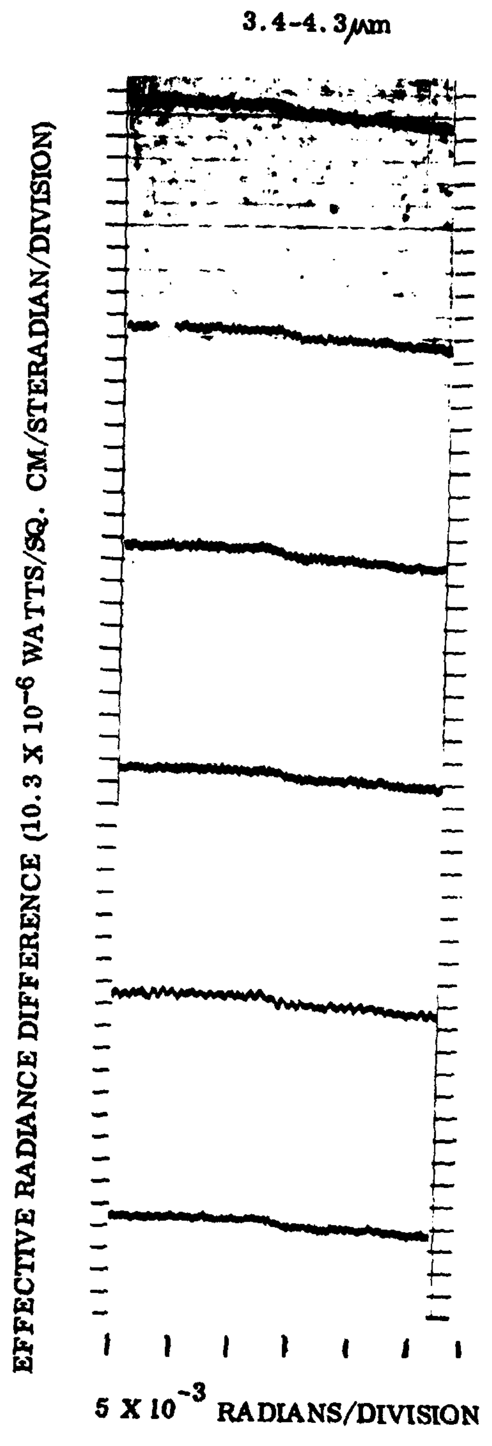
4.4-4.77μm



TARGET 51

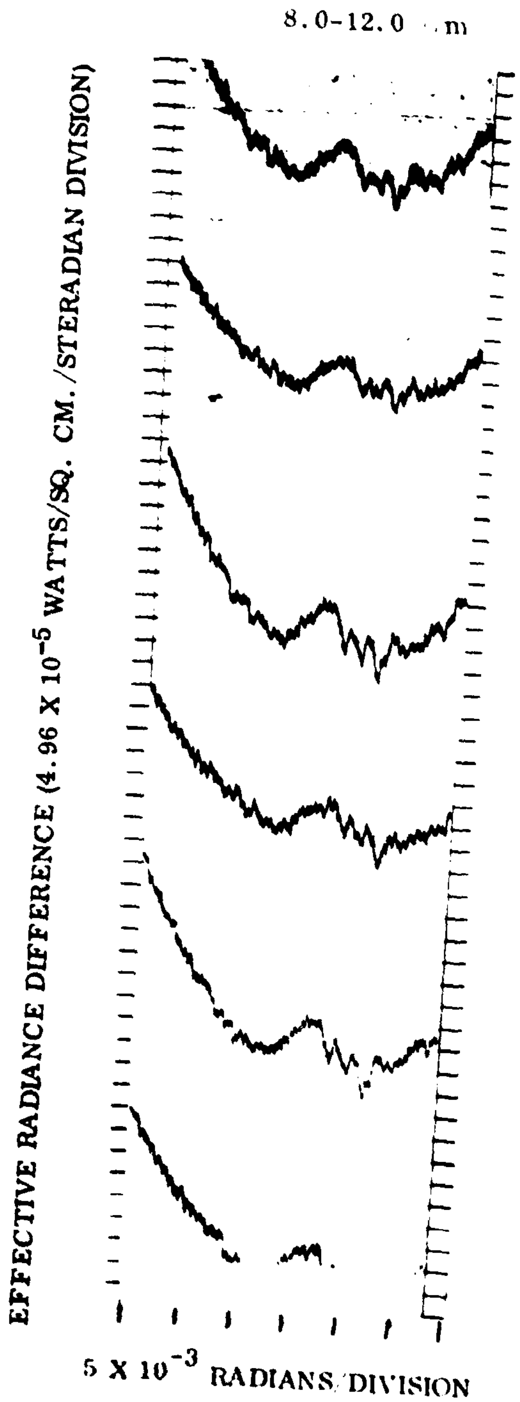


3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

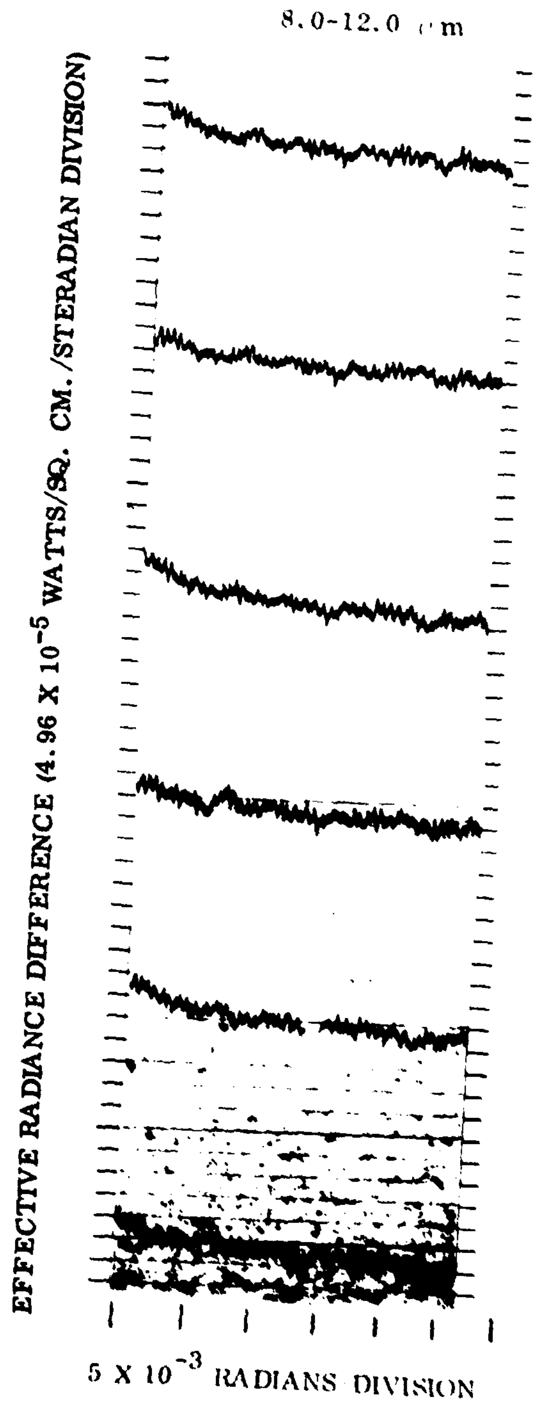


3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 51

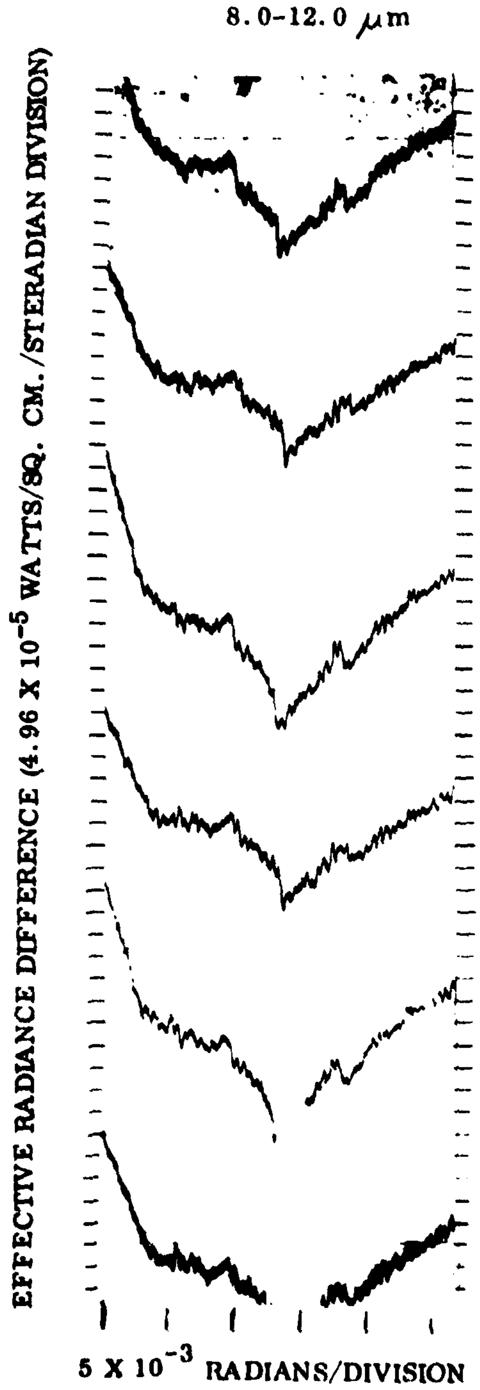


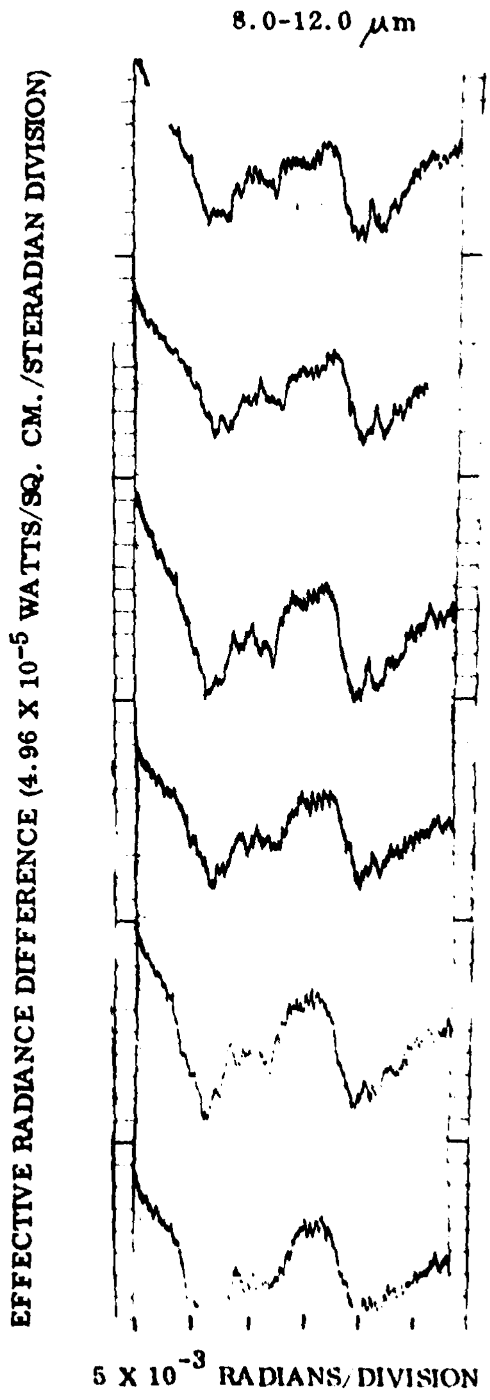
8.0-12.0 μm
EFFECTIVE RADIANCE DIFFERENCE (4.96 X 10^-5 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION



8.0-12.0 μm
EFFECTIVE RADIANCE DIFFERENCE (4.96 X 10^-5 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS DIVISION

TARGET 51

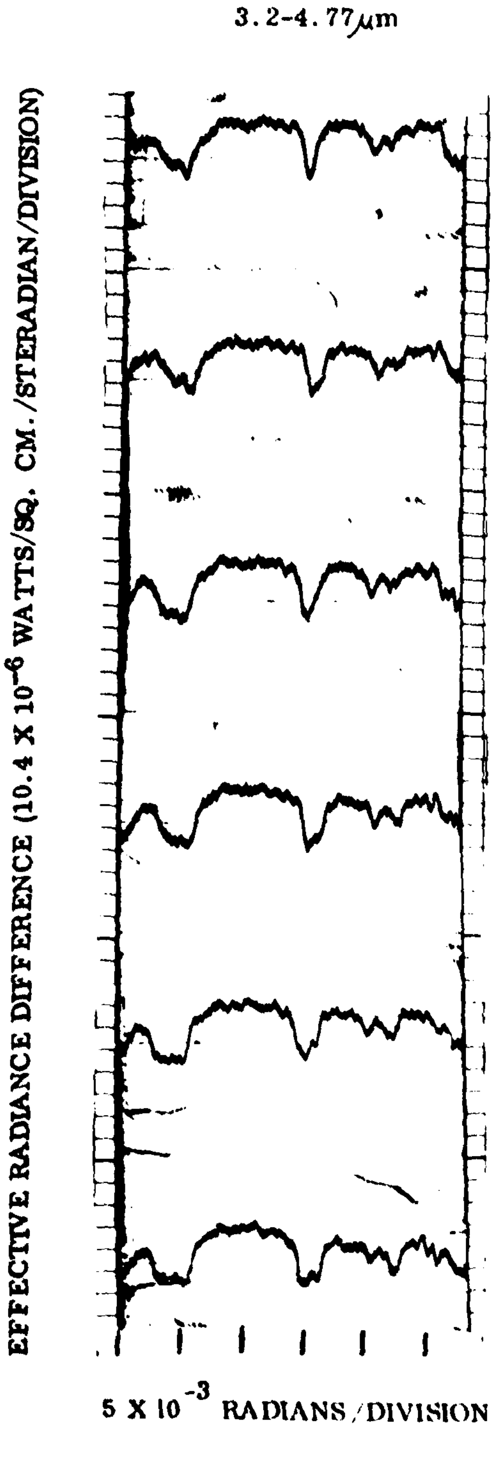

8.0-12.0 µm
EFFECTIVE RADIANCE DIFFERENCE (4.96 X 10^-5 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION


8.0-12.0 µm
EFFECTIVE RADIANCE DIFFERENCE (4.96 X 10^-5 WATTS/SQ. CM./STERADIAN DIVISION)
5 X 10^-3 RADIANS/DIVISION

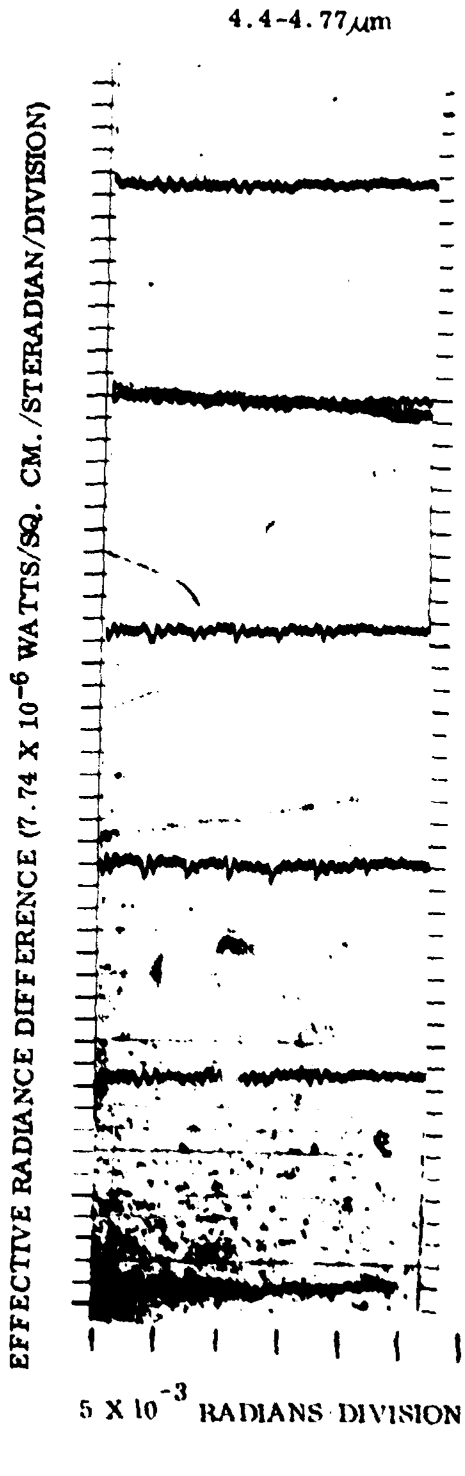
TARGET 56

DATE: 9 MAY 1979
TIME: 10:37
TEMPERATURE: 84°F
RELATIVE HUMIDITY: 66%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 95°
TARGET ELEVATION: 8.3°
SUN TO TARGET ASPECT ANGLE: 111°

TARGET 56



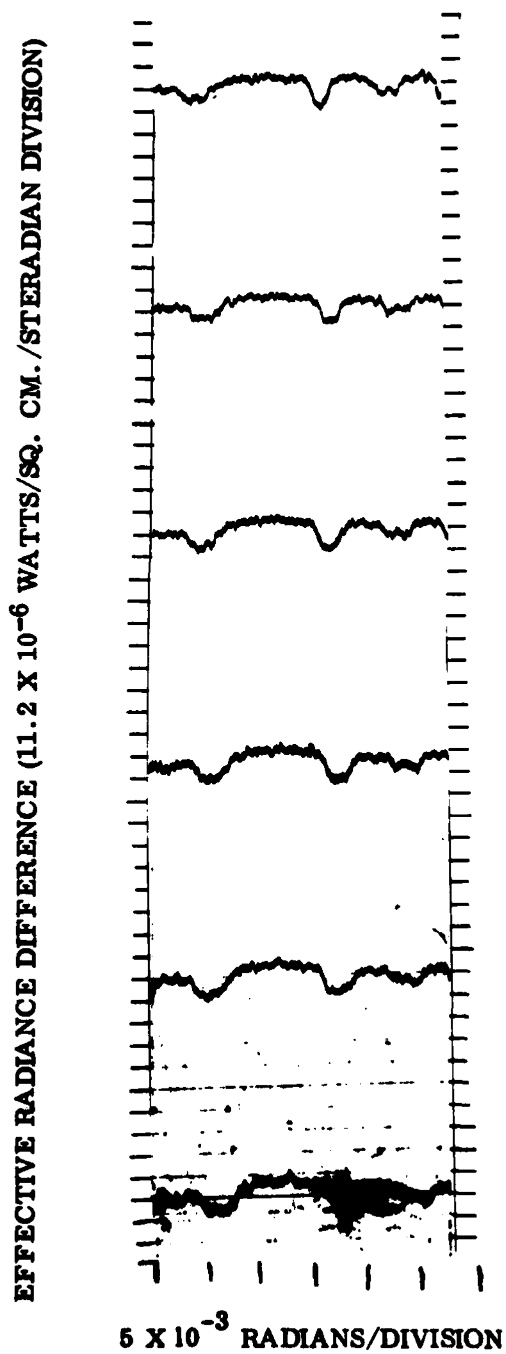
3.2-4.77 μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION



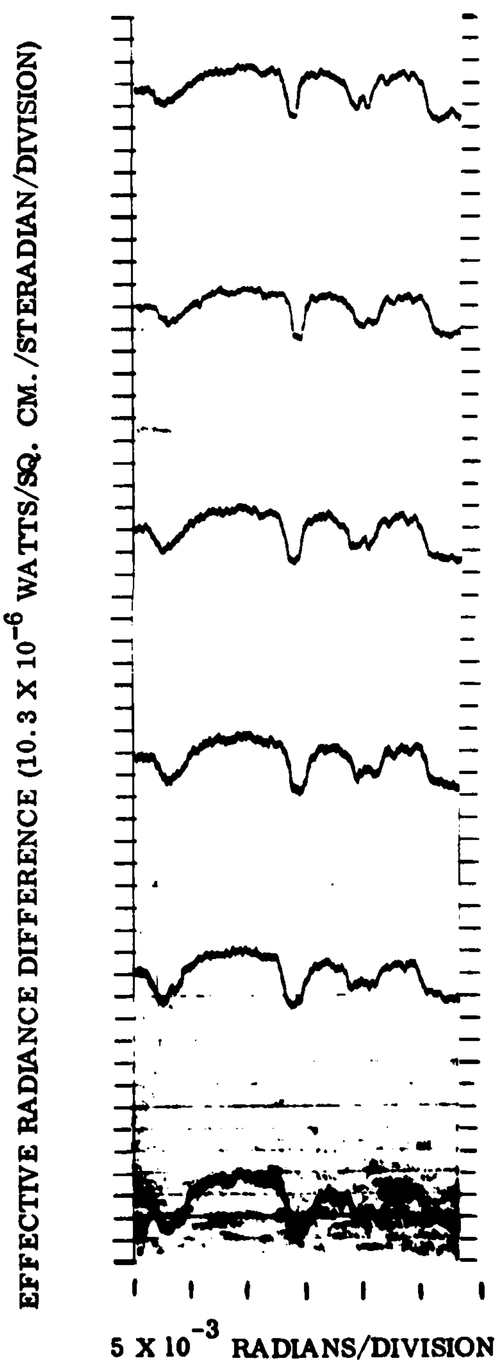
4.4-4.77 μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS DIVISION

TARGET 56

3.8-4.2μm



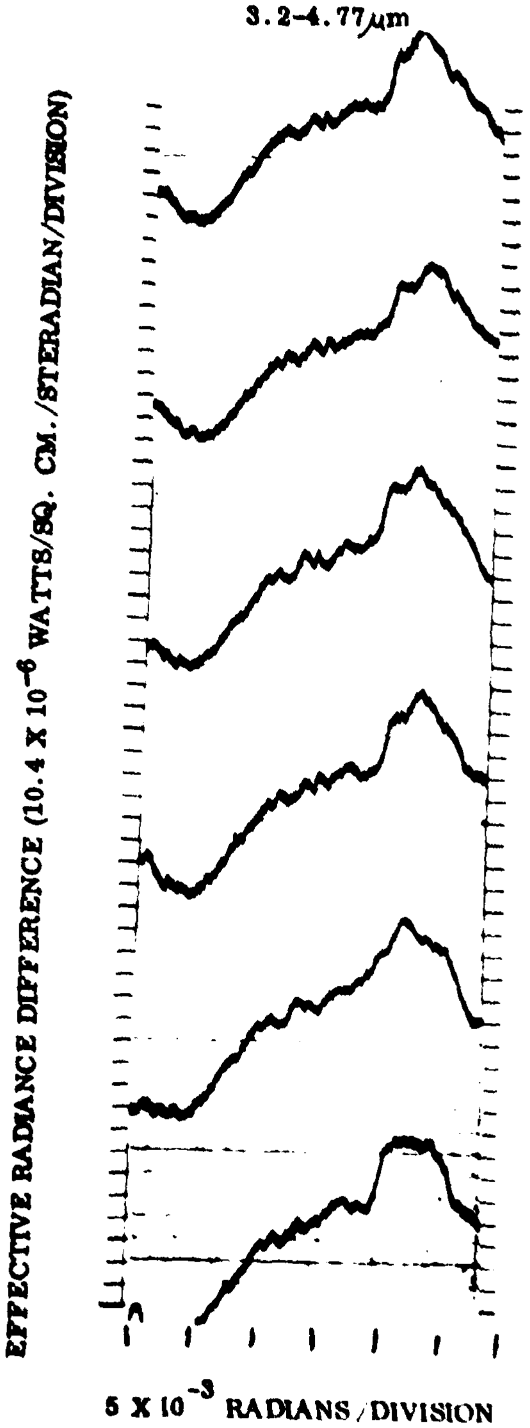
3.4-4.3μm



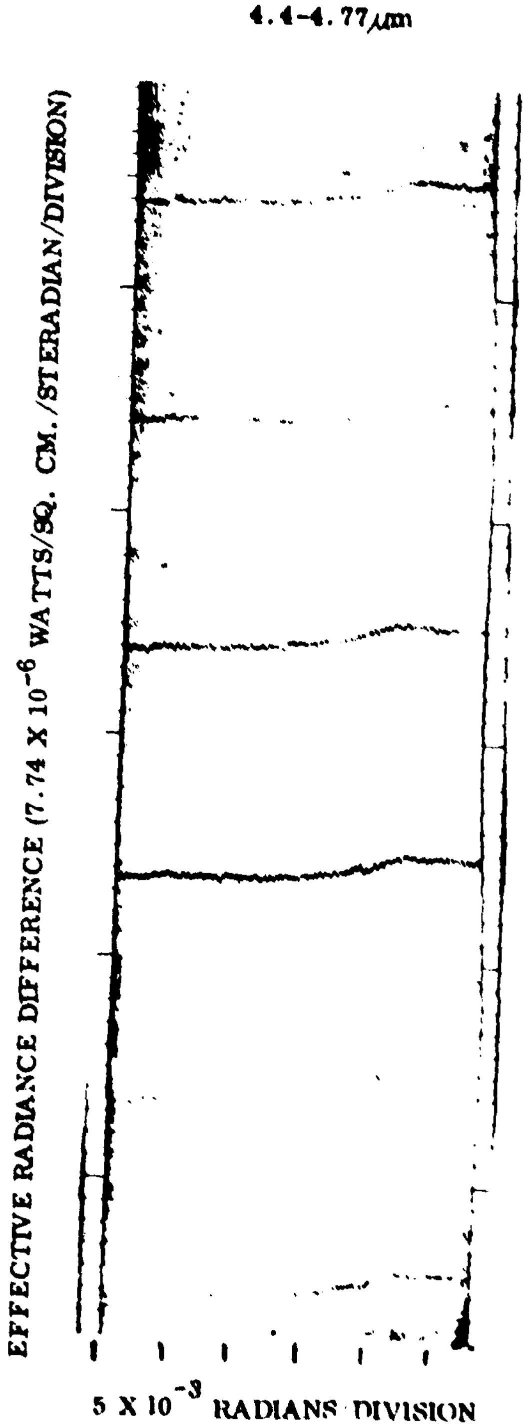
TARGET 57

DATE: 10 MAY 1979
TIME: 9:32
TEMPERATURE: $84^{o}F$
RELATIVE HUMIDITY: 55%
VISIBILITY: 7 STATUTE MILES
BAROMETRIC PRESSURE: 30 INCHES
TARGET AZ ANGLE: 114^{o}
TARGET ELEVATION: 11.4^{o}
SUN TO TARGET ASPECT ANGLE: 108^{o}

TARGET 57

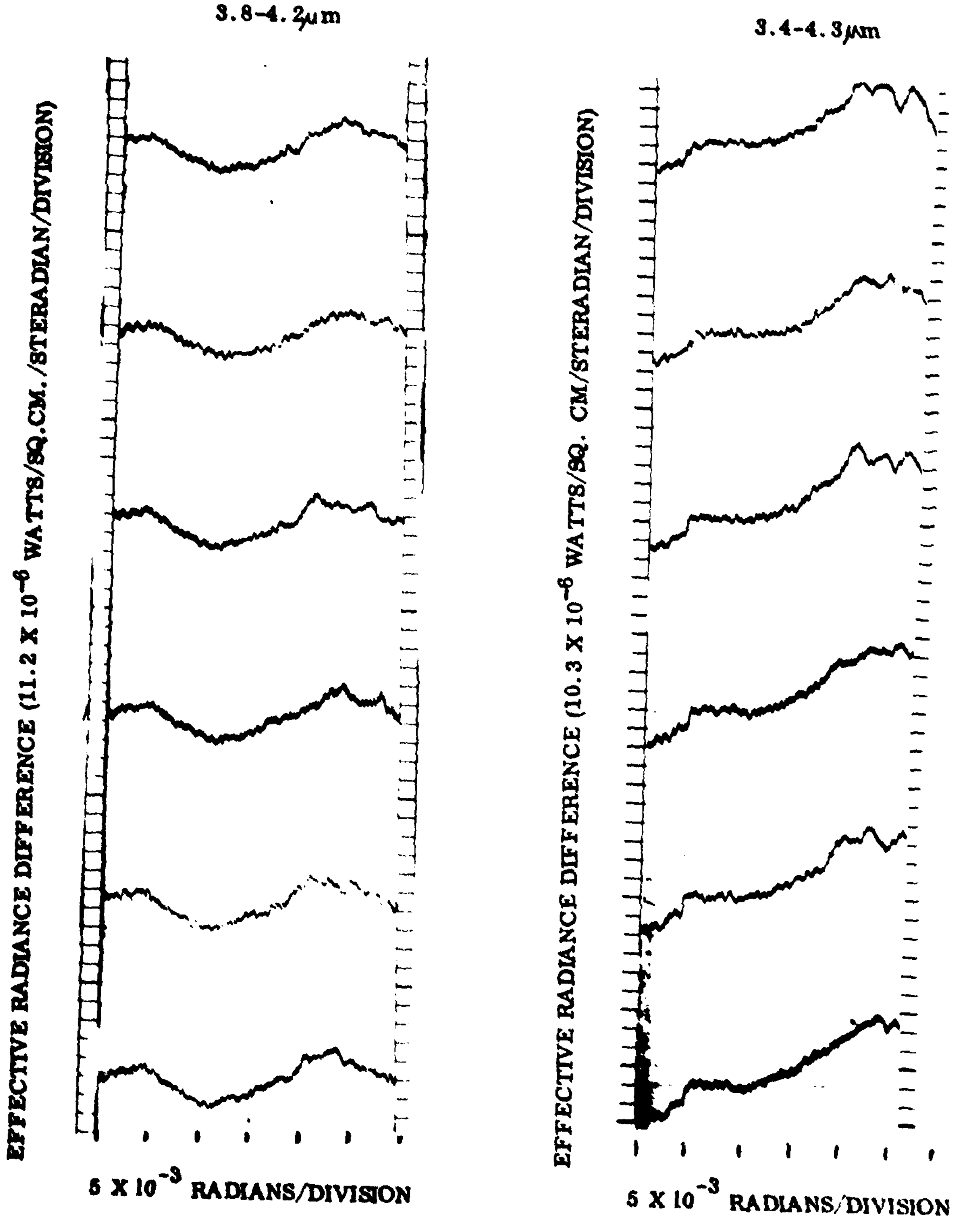


3.2-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (10.4 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION



4.4-4.77μm
EFFECTIVE RADIANCE DIFFERENCE (7.74 X 10^-6 WATTS/SQ. CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

TARGET 57



3.8-4.2μm
EFFECTIVE RADIANCE DIFFERENCE (11.2 X 10^-6 WATTS/SQ.CM./STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION
3.4-4.3μm
EFFECTIVE RADIANCE DIFFERENCE (10.3 X 10^-6 WATTS/SQ. CM/STERADIAN/DIVISION)
5 X 10^-3 RADIANS/DIVISION

AD-A081 052 CINCINNATI ELECTRONICS CORP OH F/G 17/5
RADIOMETRIC MEASUREMENTS BY THE MIDAS III SYSTEM AT KEY WEST. V--ETC(U)
SEP 79 A GEISER, C DIPPEL, V O'CONNELL N60530-79-C-0031
UNCLASSIFIED CTR-79-0012 NL

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SUPPLEMENTARY
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SUPPLEMENTARY

INFORMATION

AD-A099 158

CORRECTIONS TO:

"RADIOMETRIC MEASUREMENTS BY THE MIDAS III SYSTEM
AT KEY WEST. Volume I: Cloud Backgrounds"

CINCINNATI ELECTRONICS CORP. TECHNICAL REPORT CTR-79-0012

CONTRACT NO. N60530-79-C-0031

The attached revised pages should be used to replace the corresponding pages of the original report. On the first page of the Target 2 data, the 3.2-4.77um traces and the 4.4-4.77um traces were interchanged in the original report.

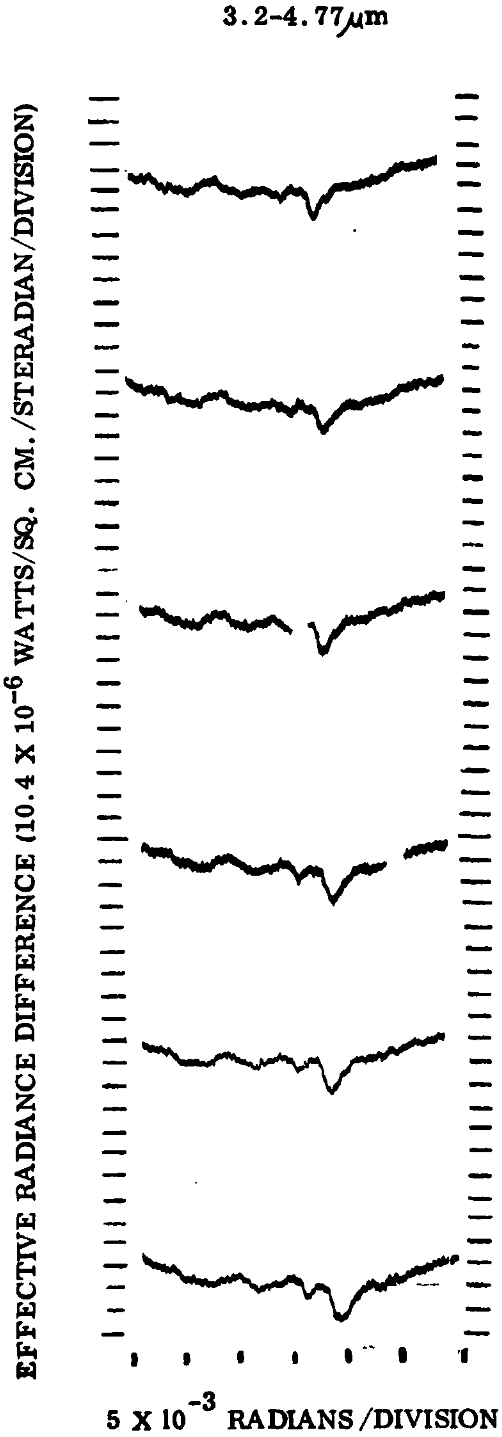
On the two pages of the Target 33 data, erroneous calibration factors were used.

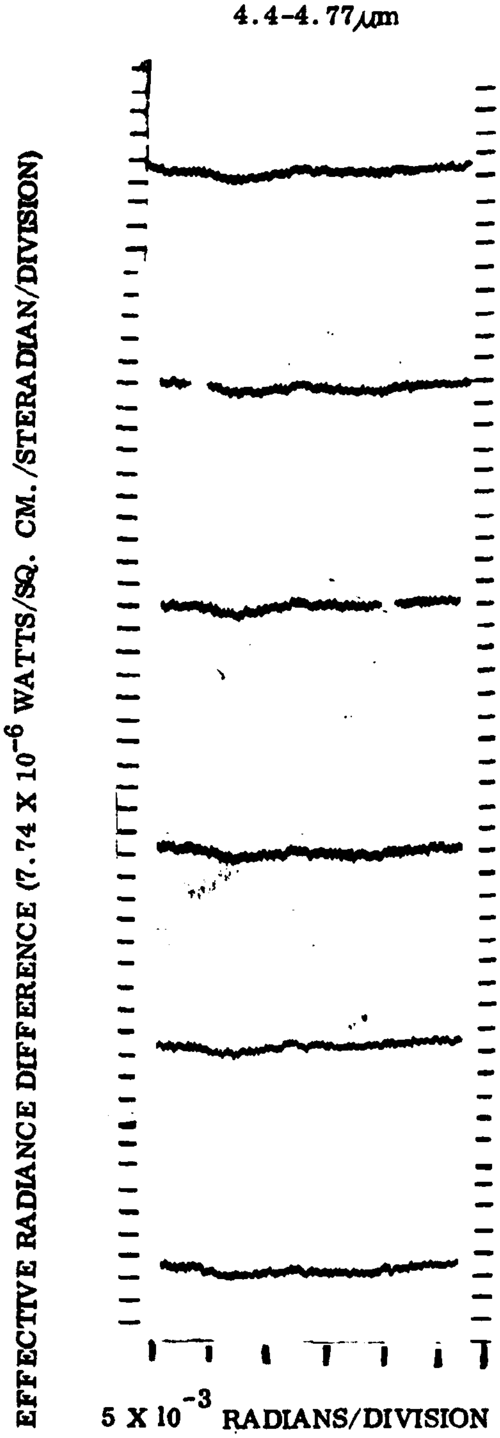
The above errors have been corrected in copies of the report issued by CE Corp. after January 27, 1981. Erroneous copies will lack the revision notice in the upper left corner of the affected pages.

81 5 08 010

TARGET 2

Revised 1-14-81

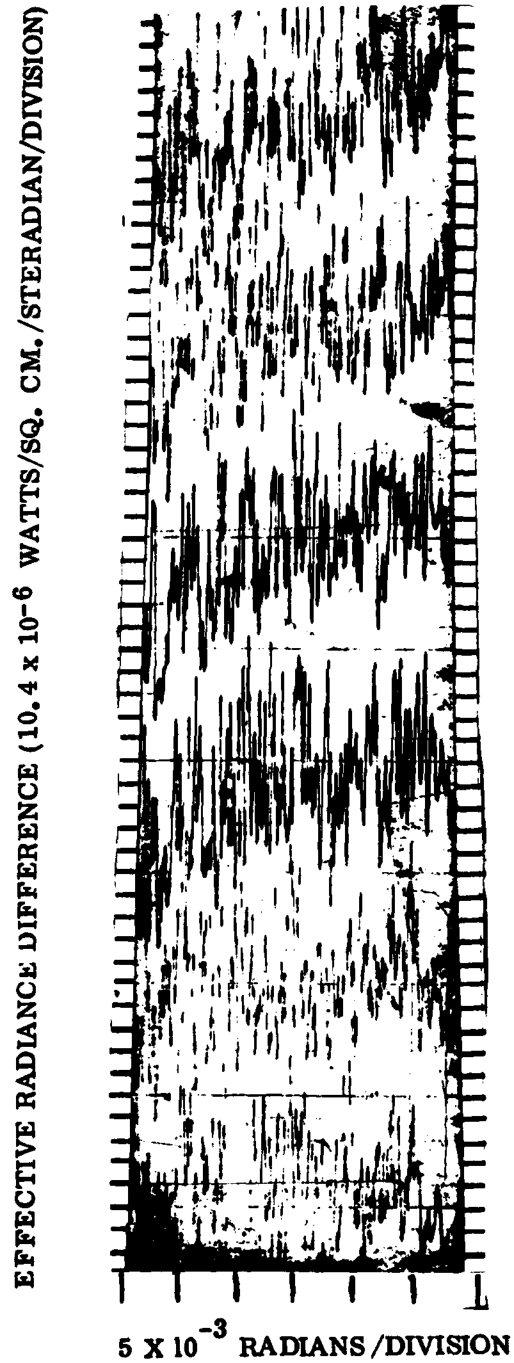




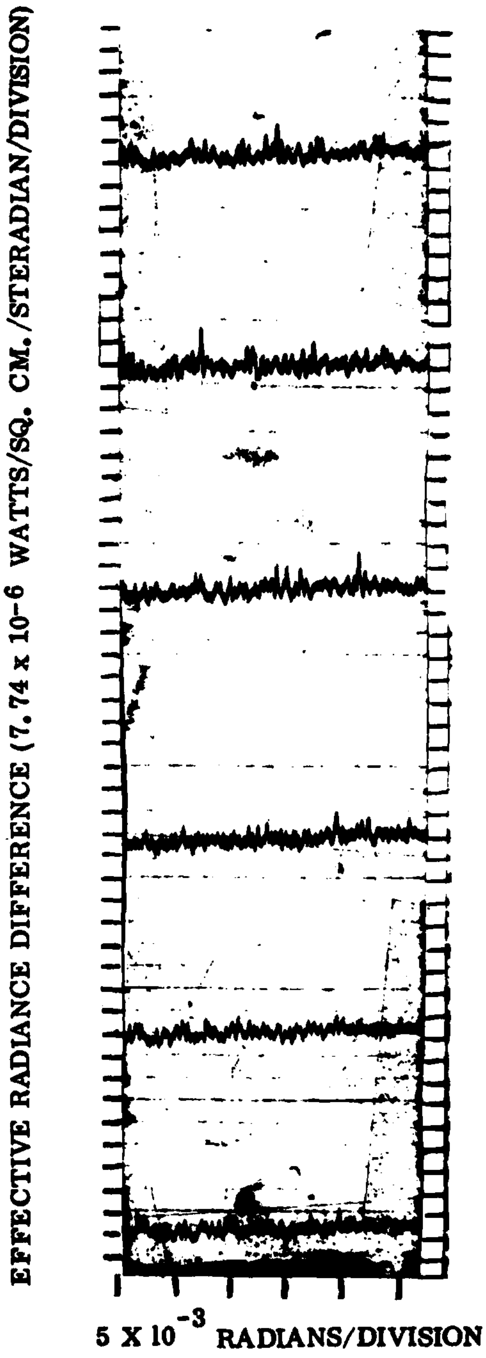
TARGET 33

Revised 1-27-81

3.2-4.77μm



4.4-4.77μm



TARGET 33

Revised 1-27-81